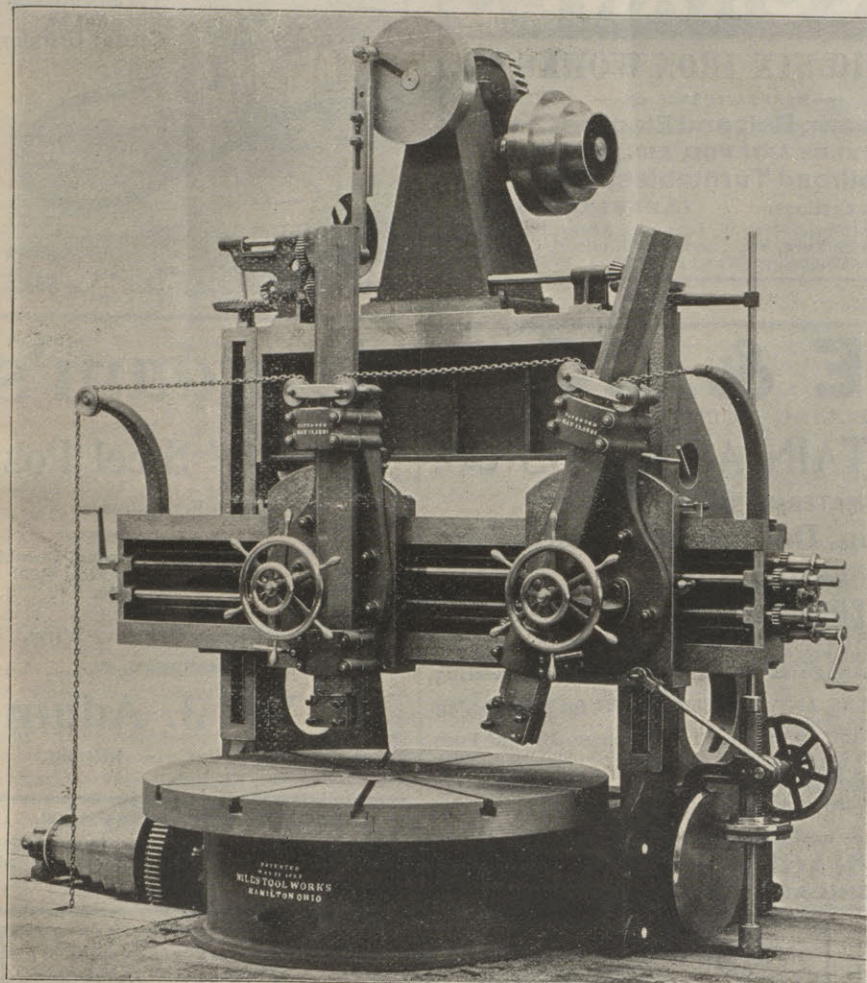


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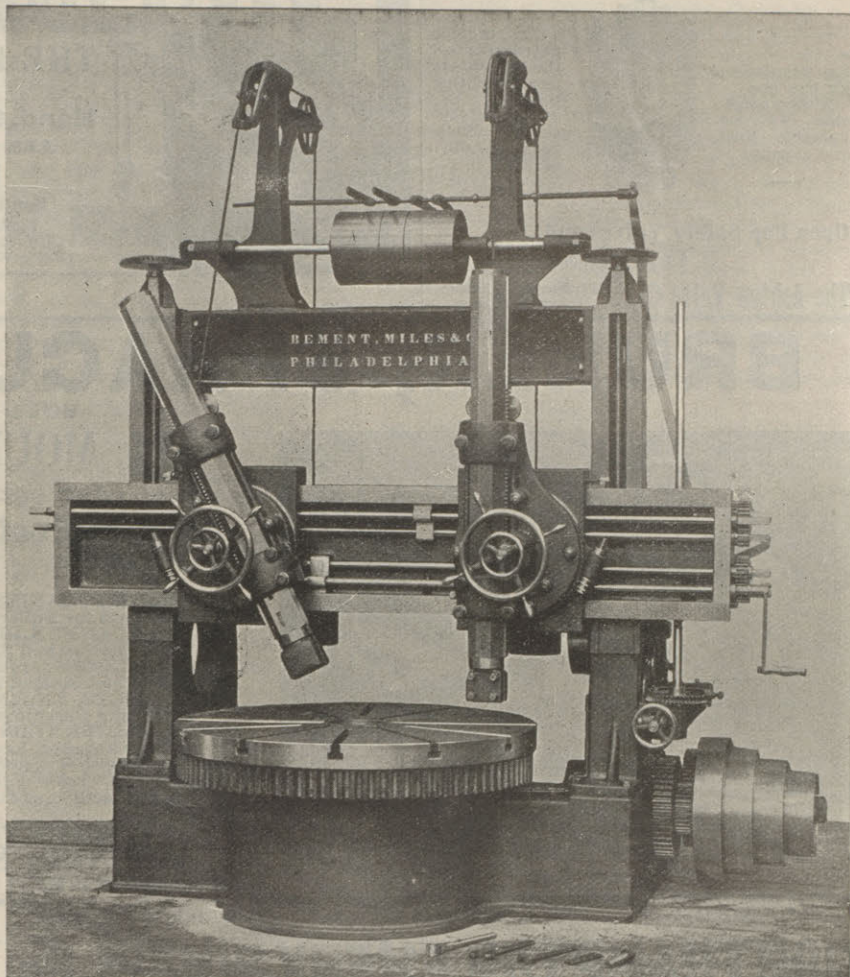
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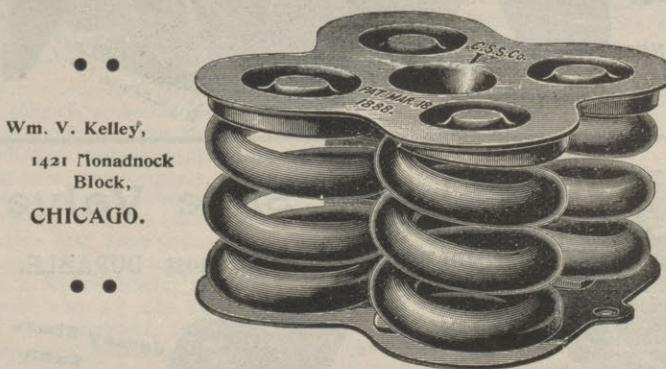
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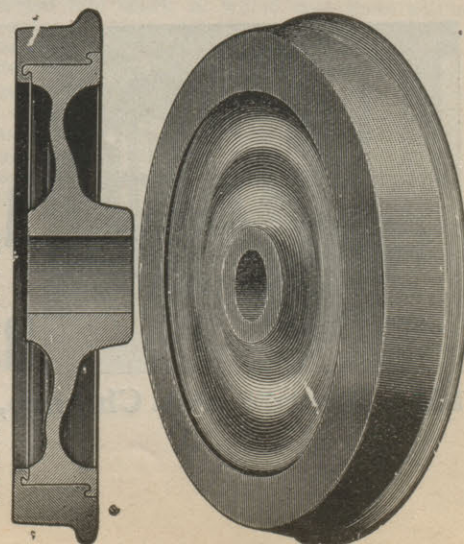
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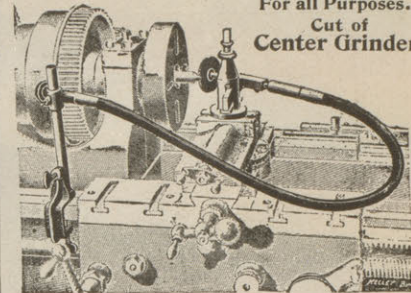
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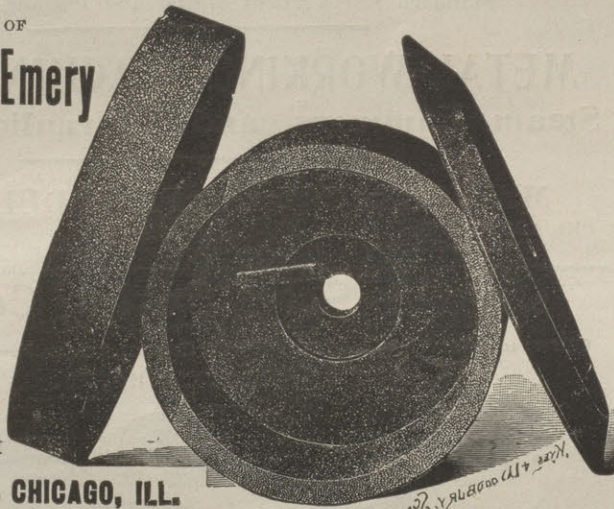
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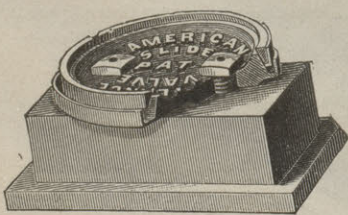
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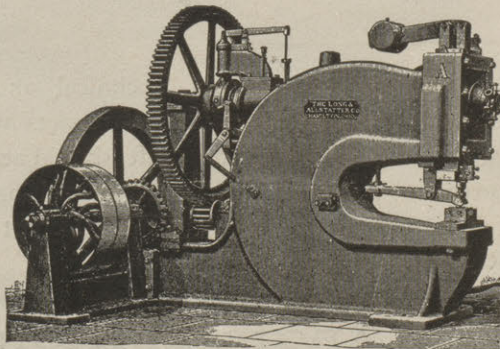
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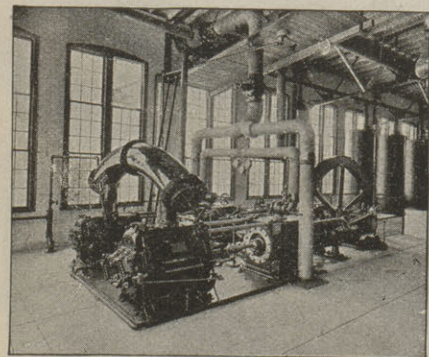
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THE RAILWAY REVIEW

No. 28.

JULY 11, 1896.

XXXVI.

CARE REQUIRED FOR TUNNEL WORKMEN.—During the construction of the Simplon tunnel every possible alleviation will be made for the workmen employed. On leaving the tunnel when they are hot and wet through they will go at once to the douche and bathrooms provided for their accommodation, where after a refreshing shower bath, they will resume their dry clothes. The sheds from which the workmen leave the tunnel are to be covered in and closed at the sides so as to protect them from cold. Drinking water will be taken at intervals to the workmen who may require it, either from the pipe which feeds the drills or from that which brings water for cooling. No provision has so far been made as regards workmen's lodgings, because it is supposed that they will easily find accommodation in the neighborhood. As it is believed that the temperature of the rock of the Simplon tunnel may reach a maximum of 104 deg. F., costly measures will have to be taken to cool the air in many parts where the works are to be carried on.

ROTARY HYDRAULIC ENGINES.—A paper upon "Hydraulic Rotative Engines" recently read before the Society of Engineers at Whitehall, England, by Mr. Arthur Rigg, gives a great deal of information upon a subject which has not received much attention from engineers, and perhaps not as much as it deserves. The author expressed surprise that so much time was devoted to the study of turbines, and to the economical use of steam, while so little had been given towards economizing pressure water. Steam engines driving hydraulic pumps are now generally constructed on the compound system, so that the cost of pressure water is less than half of what it used to be; but no corresponding improvement has been made in its application to cranes and hydraulic motors. These mechanisms reveal a greater extravagance in their development of water power than accompanied the use of steam, even before the days of Watt. He described the principal types of hydraulic rotative engines as made by Armstrong and others, and went into a theoretical examination of the variations which occur in different kind of engines, showing how the peculiar behavior of some of these engines can be accounted for. The last portion of the paper was devoted to the theory and construction of the revolving cylinder type, and to the author's own improvements on these, whereby hydraulic engines are now constructed so that they can be governed automatically, no longer requiring to use the full amount of water as if working at the maximum power when running without doing work, but the water admission regulated, for the first time in the history of hydraulic engines, in such a way that economy, as scientific and complete as in any steam engine, can now be effected with perfect ease.

THE ABUSE OF TITLES.—One of the greatest grievances of the engineering profession is that anyone, however inexperienced and incapable, can write after his name the letters C. E. or the symbol M. E. Similarly, anyone can describe himself as a metallurgist or a mining engineer without incurring any penalty. A recent writer has pointed out the absurdity and injustice of the fact that the lawyer who gets his fees whether he wins or loses his case, and the doctor who buries his mistakes underground, while the engineer who errs buries himself, are protected by a law which prevents unfair competition, while the engineering profession, holding as it does, under its care millions of lives each day, is open to the irresponsible warfare of anyone who may choose to hang out a sign styling himself an engineer, whether he poisons a city with bad water or runs a sausage machine. In fact, the latter class of engineers bid fair to own the entire field, leaving the man of education and experience sunk at the bottom of an unclassifiable jumble of trades, with his birthright taken away from him, and undistinguishable from them excepting by the individual pre-eminence he may conquer among his clients. The name of his occupation has been rendered meaningless. The Institution of Civil Engineers in this country has tried to separate the sheep from the goats, but with very doubtful success. We will undertake to name many a M. Inst. C. E. who is not an engineer, and who has scarcely had the rudiments of engineering training. The grievance was a real one for those who have devoted much time, labor and outlay in qualifying themselves for an arduous and honorable profession. [Engineering Review (London).]

MANUFACTURE OF RUBBER HOSE AND TUBING.—So little is known concerning the manufacture of rubber hose that the following notes on German practice given in a recent issue of the Trade Journal's Review will be interesting in connection with the production of this material in this country: According to Bruno Schafer, seamless rubber tubing cannot be made by the machinery in sizes of more than 0.8 in. diameter. The principle is the same as that of making lead piping. Both the cylinder and the matrix are to be heated. He proposes the following mixtures for medium qualities: White—2.5 kilograms of rubber (African), 3 of zinc white, 1 of chalk, 2.5 of white factice (composition), 0.1 lime, 0.2 sulphur; grey: 2.5 rubber, 3 zinc white, 1 chalk, 0.03 soot, 2.5 factice, 0.1 chalk, 0.2 sulphur; black: same as before, but 0.3 soot; red: 2.5 rubber, 2.5 factice, 1 golden of sulphide of antimony (15 per

cent of sulphur), 0.3 English red (iron), 1.5 zinc white, 0.2 sulphur, 0.1 lime. The mixture is well rolled; wooden splinters must be avoided, as they get into the finer channels. The tubes leaving the cylinder are rolled in talc (French chalk), antimony sulphide, or soot. Larger size hose is made by hand-work, and requires great skill and care. It is made on zinc iron pipes, 60 ft. and more long, which are well rubbed with talc, and then covered with the mixture, previously rolled, white: 2.5 Para rubber, 1.5 zinc white, 1 antimony sulphide, 0.1 sulphur. To this first layer, which must be freed of air bubbles, by pricking or other means, a second layer often of inferior quality is applied; this layer may be glued with the help of a little benzine. Then comes the alpaca or other textures, in one or several layers with intermediate thicknesses of rubber. Wire and hemp are embodied in the same way. The finished hose, very carefully bound with wet nettle, is placed on a truck, suspended not to be pressed out of shape, and brought into the vulcanisers, where it is exposed for two or three hours to steam of 35 or 40 lbs. pressure. The nettle strips are taken off and the hose pulled from the iron tube or mandrel on which it has been all the time. Such hose is rarely made in lengths of over 100 feet. Greater lengths are prepared on coated ropes, but the process is expensive. The article in "Uhländ's Practischer Maschinen Constructeur" adds some remarks on the manufacture of rubber washers and mats, generally made in hydraulic presses between iron plates. For these purposes the author considers the addition of large quantities of waste, 5 parts by weight to 2.5 of rubber and 2.5 of factice, as permissible.

TRAFFIC VIA THE "SOO" CANAL.—Comparative statement of commerce east and west bound through St. Mary's Falls canal, Michigan, for month of June, 1896:

EAST BOUND.				
Items.	Designation.	U. S. Canal	Can. Canal	Total.
Copper.....	Net tons.....	11,737	4,449	16,186
Grain.....	Bushels.....	1,785,035	1,371,068	3,156,103
Building stone.....	Net tons.....	1,983	1,140	3,123
Flour.....	Barrels.....	673,306	248,843	921,649
Iron ore.....	Net tons.....	906,080	682,339	1,588,419
Iron, pig.....	Net tons.....	1,948	2,560	4,508
Lumber.....	M. ft. B. M.....	109,136	7,900	117,036
Silver ore.....	Net tons.....
Wheat.....	Bushels.....	2,344,687	1,476,544	4,821,231
Unclass'd frt.....	Net tons.....	25,839	13,312	39,151
Passengers.....	Number.....	1,129	1,065	2,694

WEST BOUND.				
Items.	Designation.	U. S. Canal	Can. Canal	Total.
Coal (hard).....	Net tons.....	39,769	32,259	72,028
Coal (soft).....	Net tons.....	265,982	155,930	421,912
Flour.....	Barrels.....
Grain.....	Bushels.....
Manuf'd iron.....	Net tons.....	11,574	9	11,583
Salt.....	Barrels.....	47,552	1,401	48,953
Unclass'd frt.....	Net tons.....	32,88	11,793	44,676
Passengers.....	Number.....	1,1652	1,449	2,614

East bound freight, net tons.....	2,129,990
West bound freight, net tons.....	560,597
Total.....	2,690,587
Total craft—United States.....	2,414
Total craft—Canadian.....	1,066
Total registered tonnage—United States.....	1,899,380
Total registered tonnage—Canadian.....	999,187
	2,898,567

ANNEALING STEEL.—The American Artisan, having stated that for annealing steel there is no better material than charcoal, is courteously reminded by The Engineer (New York) that some kinds of steel cannot be thus annealed. The editor of The Engineer was formerly interested in the sale of steel for manufacturing purposes, and in discussing the point thus raised, he favors his readers with an interesting and instructive leaf from his own experience. He says: "In 1865 we sold a quantity—40 tons—of decarbonized gun steel to a Rhode Island firm for making rifle barrels. This steel was all cut to short lengths and was useless for any other purpose. It was annealed by the buyers, and when they came to drill it, it was found impossible to touch it with a tool. The steel was rejected and held subject to our order. This was a serious matter, for at that time steel was worth something like ten cents gold. We were sent to investigate the method of annealing and found that it had been treated in the manner described above. This seemed to us the cause of the trouble, for, as we argued, annealing decarbonized steel in charcoal for a matter of three days (heating and cooling) turned it into cemented steel, and it had the appearance of it when broken; a bar of it struck across an anvil sharply broke like glass, with a crystalline fracture. We ordered all the steel reannealed in spent gas house lime, used in the purifiers, we believe, of which large quantities can be had for nothing. This proved entirely satisfactory, and the steel worked perfectly under every tool. Spent gas house lime is the best vehicle for annealing steel we ever found or heard of; the steel is more like lead than steel, and its hardening qualities and durability are unimpaired. Twenty-four hours—even 12 hours—are sufficient to anneal the steel in lime."

OLD RAILS AS RETURN FEEDERS.—According to the Electrical World, one of the cheapest ground returns that can be built may be constructed of old rails. Flat rails are the most convenient for the purpose, and are usually the most available. They may be readily laid between the rails or in the devil strip. It is necessary, however, in

order that the rail thus laid shall materially reduce the resistance of the return circuit, that it be exceptionally well bonded, otherwise there will be little gained. One point may be noted as being extremely favorable in this class of bonding. The rail is not subject to continuous jar as in the case of rails doing at the same time mechanical service, still the joints are subject to the gradual motion of expansion and contraction. The bond must, therefore, be flexible or it will gradually work loose. If such a feeder were laid with its joints staggering those of an active rail and cross bonded thereto, the failure of a bond on either rail would be provided for. By drawing a sketch of the two rails and the bonds, it will be seen that by staggering the rails each joint is bridge by a rail, the path having four bond joints. If the joints are opposite the number of bond joints in this reserve bridge is increased to six. The use of old rails for this purpose is very advisable, being both economical and durable. The electric continuity of the bond may be preserved from corrosion by imbedding it in an asphaltic compound. It is indeed singular that this method is not more widely used on the bonds of active rails.

THE BALTIC CANAL.—The results of the opening of the Baltic Canal to general traffic have not fulfilled the expectations of its promoters. During the eight months which have passed since its official opening, until the end of February, 8,800 vessels of 976,478 tons have passed through from one sea to the other, the receipts not exceeding 605,050 marks. The calculations of the managers have therefore proved far too sanguine, for they relied upon an annual traffic of 7½ millions of tons producing about 5 millions of marks. In addition, the canal is only frequented by vessels of small tonnage, the average not exceeding 110 tons. These disappointing results are not at all surprising. The canal is, of course, a waterway of great strategical importance for the imperial fleets. It permits the German naval forces to concentrate themselves either in one sea or the other in a very few hours; but although in theory this canal really shortens the distance for vessels, still that is not the only thing to be taken into consideration. The shortening of the distance should also hold out pecuniary advantages, and when only a few hours, or a day at the most, are saved, the larger number of merchant ships prefer the high seas to a canal requiring a toll. It does not matter to them whether their goods are delivered a few hours sooner or later, for as they are rarely unloaded immediately on arriving, a slight delay is not of much importance. Again, taking into account the tariffs on the canal fixed by the imperial administrators, the larger number of vessels find it cheaper to go round by the Belts rather than through the Baltic Canal. At the present moment, the expenses of the canal amount to 3 millions of marks while the receipts will not amount to more than 900,000 marks this year. The imperial budget will have to make good the difference.

WATER PRESSURE AT TWO HUNDRED FEET.—A crushed mass of iron now lying in a scrap yard at Pittsburgh demonstrates the tremendous pressure of water at a great depth. It was constructed for a diving bell, and was intended for use in Lake Michigan. As originally constructed it was a cube about six feet square, tapering slightly at both ends. The material was phosphor bronze, five-eighths of an inch thick. Each plate was cast with a flange and they were bolted together, the bolts being placed as closely together as was consistent with strength. The side plates were further strengthened by ribs an inch thick and two inches wide, and the entire structure was strongly braced. The windows, intended to be used as outlooks by the divers inside, were three inches square, fortified with iron bars and set with glass plates one inch thick. The entire weight of the bell was 23,000 lbs. When completed it was sent to Milwaukee and towed out into the lake about twelve miles, where there was over two hundred feet of water, and was sent down for a test. The manufacturer of the bell was so confident of its strength that he wanted to go down in it on the test trip. It was well he did not. When it had reached a depth of about two hundred feet, strong timbers which had been attached to it came to the surface in a splintered condition. Suspecting an accident, the bell was hauled up and found to be crushed into a shapeless mass. The inch thick plate glass bell's eyes were pulverized and the entire body of the bell forced inward until none of its original outlines remained. On a basis of two hundred feet depth, the pressure that crushed this seemingly invulnerable structure was 86.8 lbs. per square inch, or 353,924 lbs. to each side of six feet square. The total pressure, therefore, on the cube was 2,723,548 lbs., or 1,361.7 tons.—Indianapolis Journal.

PRIORITY OF PREFERRED STOCK.—The default on July 1 of the receivers of the Baltimore & Ohio Railroad Company's preferred stock created considerable interest the past week in financial and railroad circles, because of the character of the preferred stock, which has been generally recognized as a first claim against the company's gross earnings. It is probable that the matter will be carried into court, in which case there will be some important and interesting litigation. The Railway World calls attention to the fact that this is not, however, the first time that default has been made in this country upon a guaranteed preferred stock. In March, 1878, Daniel K. Stewart, of England, filed a petition in the United States circuit court for the eastern district of Virginia against the Atlantic, Mississippi & Ohio Railroad Company (now the Norfolk & Western), in which he demanded payment of interest on 145 shares of stock known as "guaranteed preferred stock," which was issued by the Virginia & Tennessee, a division of the Atlantic

Mississippi & Ohio. He had received this interest (6 per cent per annum) until the Virginia & Tennessee was placed in the hands of receivers. His claim was that this interest was due before any payments were made upon any other indebtedness of the Virginia & Tennessee inferior to the second mortgage bonds of that company. This stock which was only a part of the total issue of common stock, was guaranteed by the board of directors. Judges Hugh L. Bond, and R. W. Hughes heard the case and decided in favor of the plaintiff, and an order was made that the interest be paid in a manner prescribed in the resolution of the board of directors. This case, it is said, is similar in many respects to that of the Baltimore & Ohio, and the reference to it is, therefore, interesting at this time.

NOTES CONCERNING THE PERFORMANCE OF THE PURDUE LOCOMOTIVE "SCHENECTADY."

BY PROF. W. F. M. GOSS.

The experimental locomotive of Purdue was built by the Schenectady Locomotive works in 1891. Its principal dimensions are as follows:

Total weight (makers' figures).....	85,000 lbs
Weight on four drivers' (makers' figures).....	50,000 lbs
Total wheel base.....	22 ft. 11 in
Driving-wheel base.....	8 ft. 6 in
Drivers, outside diameter of tire.....	63 in
Cylinders:	
Diameter.....	17 in
Stroke.....	24 in
Ports:	
Length.....	16 in
Width of steam ports.....	1 1/4 in
Width of exhaust port.....	2 1/2 in
Richardson balanced valves:	
Maximum travel.....	5.53 in
Outside lap.....	3/4 in
Inside lap.....	1-3/32 in
Boiler:	
Diameter waist at front end.....	52 in
Diameter tubes.....	2 in
Number of tubes.....	200
Width of fire box.....	34 1/2 in
Length of fire box.....	72 in
Total heating surface, square ft.....	1,214.4
Grate surface, square feet.....	17.5

This locomotive is mounted in the laboratory in such a way as to allow its action to be studied and its performance tested while the engine is run at any desired speed and under any load, the conditions being similar to those of the track.

2. *Power of Locomotive "Schenectady."*—The indicated horse power developed while running under a full throttle and with a boiler pressure at 130 lbs., is shown by Table I.

SHOWING INDICATED HORSE POWER AT DIFFERENT SPEEDS AND AT DIFFERENT CUT-OFFS. BOILER PRESSURE 130 POUNDS. THROTTLE FULLY OPEN.

Speed in Miles.	Rev. per Minute.	Approx. Cut-Off in Inches of Stroke.		
		6 Inches.	8 Inches.	10 inches.
15	81	190	270	455
25	135	223	368	501
35	188	298	490	
45	242	302	437	
55	296	292	438	

The power of any locomotive is limited at low speeds by its adhesion, at higher speeds by the capacity of its boiler. For example, at a speed of 15 miles it is possible to run with a wide-open throttle under a cut-off as long as 8 in.; an attempt to run with a 10 in. cut-off was found to involve frequent slipping, the occurrence of which made it impossible to maintain conditions, but had the engine been upon the road there is no question but what this condition could have been maintained. An increase of speed to 25 miles so reduced the mean effective pressure that the 10 in. cut-off could be maintained, but at this speed the use of a longer cut-off again led to trouble by causing the wheels to slip. On the other hand, tests at speeds of 35 miles and over gave no trouble from slipping, but an attempt to lengthen the cut-off beyond the limits for which results are given in Table I. failed through lack of steam. The 10 in. cut-off test at 35 miles was successfully run only after the double exhaust nozzle had been reduced from 3 in. diameter to 2 1/4 in. diameter. It will be seen from these considerations that Table I. represents conditions of speed and cut-off which embrace very nearly the entire range of action for this locomotive while running under a full throttle.

3. *Maximum Power.*—Much interest has been manifested in information which tends to establish the maximum limits of power which can be developed by a locomotive. Engines of the size under consideration are commonly credited with a capacity of not less than 800 horse power, while as a matter of fact the highest horse power in Table I. is 501. A higher steam pressure would tend to increase the power of the engine tested and a change in valve proportions might also affect it; but judging from the data given it does not appear that any locomotive having a cylinder and boiler capacity no greater than that of the Schenectady could be forced beyond 600 horse power.

4. *Power and Speed.*—In general the power of an engine is proportioned to its speed; that is, if the speed is doubled all other conditions remaining the same, the power is doubled. This general relation must of course exist to a locomotive, but in this particular type of machine it is not possible to change the speed and maintain all other conditions constant. In fact, when the speed is changed a number of other factors insist upon changing also; and herein lies the chief difficulty which must be met by all who enter upon an analytical study of locomotive performance.

An important factor which is affected by a change of speed is the steam distribution in the cylinder, arising

*Paper presented at May meeting of the Western Railway Club.

from the changed time-interval during which the steam must enter and leave the cylinder. It is evident that a higher speed must result in an increase of power excepting under conditions which make the loss of mean effective pressure equal to, or greater than the gain in speed; that is, excepting where the loss in the amount of work per revolution is equal to or greater than the gain in the number of revolutions. The relation between speed and mean effective pressure as developed by tests is well shown by Table II. Thus, for a cut-off of six inches the mean effective pressure is reduced from 43.5 lbs. at 15 miles to 18.3 for the same cut-off at 55 miles.

Tables I. and II. both give evidence that the power of

TABLE II.
SHOWING MEAN EFFECTIVE PRESSURE AT DIFFERENT SPEEDS AND DIFFERENT CUT-OFFS. BOILER PRESSURE 130 POUNDS. THROTTLE FULLY OPEN.

Speed in Miles.	Rev. per Minute.	Approx. Cut-Off in Inches of Stroke.		
		6 Inches.	8 Inches.	10 Inches.
15	81	43.5	61.9	
25	135	30.5	51.2	63.3
35	188	29.6	42.4	48.0
45	242	23.2	33.2	
55	296	18.3	27.4	

the engine tested increases with increase of speed up to about 35 miles per hour (188 revolutions per minute). Above this limit the power remains practically constant.

5. *Power and Cut-Off.*—An inspection of Table I. with reference to the power developed at different cut-offs on the engine tested will aid in forming an opinion as to the sufficiency of the mechanism for varying the cut-off. The reverse lever quadrant on this engine has notches which are spaced 3/4 in. from center to center. When the lever is in the first, or second, or third notch the approximate cut-off is respectively 6 in., 8 in., and 10 in. A change in the position of the lever from the first to the second notch or from the second to the third, as shown by the data presented, involves a change in the output of power varying from 70 to 146 horse power. Half the changes represented by the data result in a change of more than 135 horse power. A change from the first to the second notch gives an increase of about 50 per cent of the power developed with the lever in the first notch.

6. *Steam per Indicated Horse Power per Hour.*—Engineers unfamiliar with the performance of the locomotive often characterize it as an extremely wasteful engine. The conditions under which it works are necessarily severe, but it will be seen from Table III that its performance compares favorably with that of any other class of single cylinder, high pressure engines.

TABLE III.
SHOWING STEAM CONSUMPTION PER INDICATED HORSE POWER PER HOUR AT DIFFERENT SPEEDS AND DIFFERENT CUT-OFFS.

Speed in Miles.	Rev. per Minute.	Approx. Cut-Off in Inches of Stroke.		
		6 Inches.	8 Inches.	10 Inches.
15	81	28.93	27.66	
25	135	28.06	26.60	28.50
35	188	26.93	26.28	30.10
45	242	28.60	28.45	
55	296	30.64	32.00	

This table brings out very clearly several facts concerning the performance of the engines tested, and these may be summarized as follows:

With a full throttle the consumption does not under any conditions of speed or cut-off exceed 32 lbs. per indicated horse power per hour, and under favorable conditions it falls to about 26 lbs. In this connection it may be noted that with a higher steam pressure this engine has given one horse power per hour on less than 25 lbs. of steam.

The steam consumption per indicated horse power per hour varies with the speed and is minimum for a speed of 35 miles an hour.

The steam consumption varies with the cut-off and is not minimum for the shortest cut-off except for a speed of 55 miles an hour. This fact confirms an opinion which was reached after a study of previous tests upon this engine; namely, that a cut-off of about 3/4 stroke gives maximum results. If the load to be carried is light, it is more economical to use an 8 in. cut-off with a partially closed throttle, than to run with a shorter cut-off and a full throttle. It should be noted, however, that the loss in efficiency resulting from too short a cut-off is extremely small, whereas, such loss increases rapidly if the engine be allowed to run with a cut-off longer than that which gives the maximum efficiency. In case of doubt it is certainly safer to use the short cut-off.

7. *Coal per Indicated Horse Power per Hour.*—Table IV showing the weight of coal consumed per indicated horse power per hour, gives a measure of the combined efficiency of the boiler and engine. The boiler is most efficient when working under its lowest power, while the engine is most efficient when working at its maximum power. The efficiency of the two combined is highest somewhere between the limits of the power developed at 35 and at 15 miles per hour, or it must be coincident with one or the other of these limits. Table IV shows a nearly constant consumption of coal per indicated horse power per hour for speeds

TABLE IV.
SHOWING COAL PER INDICATED HORSE POWER PER HOUR AT DIFFERENT SPEEDS AND AT DIFFERENT CUT-OFFS.

Speed in Miles.	Rev. per Minute.	Approx. Cut-Off in Inches of Stroke.		
		6 Inches.	8 Inches.	10 Inches.
15	81	4.45	4.19	
25	135	4.19	4.45	5.08
35	188	4.18	4.54	6.32
45	242	4.33	5.60	
55	296	5.12	6.03	

below 35 miles per hour, but above this speed the consumption increases rapidly. For the 6 in. cut-off it is minimum at 25 miles per hour, and for the 8 in. cut-off at 15 miles; it is curious that the value given for these two points is the same.

8. *Critical Speed.*—It has been shown (paragraph 4) that with the throttle fully open and the cut-off constant, the power of the locomotive increases as the speed is increased up to a certain point, after which the power does not increase even though the speed is increased. I have called that speed which represents the point on the scale where the power ceases to increase, the critical speed. It is always a little dangerous and commonly unnecessary to attempt the introduction of a new term, and the caption of this paragraph was chosen with some hesitation. Its choice sprang from a desire to give emphasis to a series of relationships which are noted in the preceding paragraphs and which, so far as I am informed, have not before received attention. It is an interesting fact that the steam consumption per horse power per hour is lowest when the engine is running at its critical speed (paragraph 5) and equally interesting is the fact that the coal consumption per horse power per hour (paragraph 6) is practically constant for all points below the critical speed. These relationships are of such a character as to make it appear probable that they will be found true for all locomotives, in which case the critical speed becomes an important factor to be considered by the designer of locomotives. For the locomotive tested, the critical speed is about 35 per hour (188 revolutions per minute) or approximately 200 revolutions per minute. It is possible that different valve settings, or different valve proportions may have some effect upon the value which is here assigned to the critical speed but so long as the link motion is used the limits of its variation cannot be great.

9. *An Argument for Large Wheels.*—It is evident from the preceding discussion that for highest efficiency, the speed of rotation of any locomotive should agree with the critical speed. This for the locomotive tested is about 200 revolutions per minute. If high rates of speed are demanded considerations of economy require that the diameter of drivers be increased to such proportions as will give the desired rate, without exceeding the critical speed. Some comparisons from the data given will serve to emphasize this statement.

Friction being neglected, the engine experimented with will give 109.4 lbs. pull to the draw-bar for every pound mean effective pressure that is exerted in the cylinders.

Its power becomes maximum at about 188 revolutions per minute (35 miles an hour.) The mean effective pressure at this speed when cutting off at 8 in. is shown by Table II to be 42.4 lbs. The equivalent pull at the draw-bar is

$$(1.) \quad 42.4 \times 109 = 4,622 \text{ lbs.}$$

If, now, it is required to increase the speed of this engine from 35 to 55 miles an hour, the revolutions must be increased from 188 to 296, causing the mean effective pressure to drop to 27.4 lbs. The equivalent pull at the draw-bar at the higher speed is

$$(2.) \quad 27.4 \times 109 = 2,987 \text{ lbs.}$$

Suppose, now, that instead of increasing the speed of rotation from 188 to 296, the diameter of the drivers be increased from 63 in., the present diameter, to 99 in. With these proportions the engine would give 69.4 lbs. pull at the draw for each pound mean effective pressure. But a speed of 55 miles would now involve only 188 revolutions per minute, and the mean effective pressure would therefore be 42.4 lbs., which would give a pull at the draw-bar of

$$(3.) \quad 42.4 \times 69.4 = 2,943 \text{ lbs.,}$$

r, practically, the same with that obtained at the same speed with the smaller wheels.

A similar comparison based on the mean effective pressure obtained with a 6 in. cut-off gives results for 55 miles as follows: With 63 in. drivers the pull at the draw-bar will be

$$(4.) \quad 18.3 \times 109 = 1,995 \text{ lbs.}$$

With 99 in. drivers

$$(5.) \quad 29.6 \times 69.4 = 2,054 \text{ lbs.,}$$

which is a gain in draw-bar stress in favor of the larger drivers.

These comparisons, based as they are upon results of accurately conducted tests, justify the conclusion that after a speed of revolution of about 200 per minute is reached, a pull at the draw-bar can be sustained equally well by increasing the diameter of wheels or by increasing the speed of rotation. Strictly speaking, this conclusion should be limited in its application to locomotives having the same valve action with that of the engine tested, but "Schenectady" may be safely taken as typical of a large class of locomotives now in service.

While the comparisons which have been made are based upon the assumption that there is no loss in the transmission of power from the cylinders to the draw-bar, it can be shown that the power equivalent of the frictional losses is greater for high than for low speeds of rotation. The effects of such friction, if allowed to influence the preceding comparisons would be to reduce the calculated draw-bar pull for the 296 revolution tests by a larger amount than for the 188 revolution tests. In other words, when engine friction is taken into account, conclusions are in favor of larger drivers.

Accepting the fact as established that within limits that can be pretty definitely defined, the draw-bar pull is not reduced by increasing the diameter of the drivers, we may inquire concerning the incidental advantages which are likely to result from the use of larger wheels for higher speeds. It has already been shown that the locomotive is most efficient for speeds at or below its critical speed, and that its efficiency declines rapidly as this speed is ex-

ceeded. This phase of the matter may now be approached more in detail.

If with the present wheels (63 in. dia.), the locomotive under consideration is required to run at a rate of 55 miles, it must make 296 revolutions per minute. The table shows that at this speed, and with full throttle, and a cut-off of 6 in., the engine requires 30.6 lbs. of steam per horse power per hour. If wheels 99 in. in diameter were substituted for those it now has, the revolutions would fall to 188 and the steam consumption to 26.9 lbs., a gain in steam consumption of 12 per cent. A similar comparison of results for tests at 8 in. cut-off gives a gain for the large wheels of 18 per cent.

This saving of steam resulting from the greater economy of the engine reduces the demand upon the boiler; fuel is saved both because less steam is required and because the boiler is permitted to work under conditions more favorable to economy.

The saving of coal which would result from the use of large wheels for high speeds is even more pronounced than that of steam. Thus it will be seen by reference to Table IV that, with a full throttle, and a 6 in. cut-off, the engine with its present wheels requires at 55 miles, 5.12 lbs. of coal per indicated horse power per hour. If, however, its wheels are increased in size, to bring its revolutions down to 188 per minute, its coal consumption would be reduced to 4.19 lbs. A similar comparison for a cut-off of 8 in. gives a saving of 23 per. cent.

There should also be credited to the larger wheels a saving in cost of repairs on engine and track, a saving in oil, and a better and more precise action of the whole mechanism of the machine, which in time would doubtless lead to still other economies.

All this is accomplished without loss of effort at the draw-bar excepting when the speed of the engine is below 35 miles an hour.

Table V. presents a convenient summary of the arguments for large drivers.

It is admitted that there are mechanical difficulties to be overcome before wheels of very large diameter can be used, and that there are in this country conditions of service which seem to require some sacrifice in performance at high speed in order that certain desired results may be secured.

TABLE V.

SHOWING CERTAIN RESULTS OBSERVED IN CONNECTION WITH LOCOMOTIVE "SCHENECTADY" AND SIMILAR RESULTS DEDUCED FROM DATA WHICH IS GIVEN ON THE SUPPOSITION THAT THE DIAMETER OF ITS DRIVERS HAD BEEN INCREASED IN THE RATIO OF 35 TO 55. SPEED CONSTANT AT 55 MILES AN HOUR. THROTTLE FULLY OPEN.

	Present Drivers 63-inch Diameter.	Proposed Drivers 99-inch Diameter.
Revolutions per minute.....	296	188
Approximate speed in miles per hour.....	55	55
Indicated Horse Power (Table I).		
6-inch cut-off.....	292	298
8-inch cut-off.....	438	431
Tractive Force, pounds.....		
6-inch cut-off.....	1995	2054
8-inch cut-off.....	2987	2943
Steam per Indicated Horse Power per hour (Table III).		
6-inch cut-off.....	30.6	26.9
8-inch cut-off.....	32.0	26.28
Coal per Indicated Horse Power per hour (Table IV).		
6-inch cut-off.....	5.12	4.18
8-inch cut-off.....	6.03	4.54
Gain or loss in Indicated Horse Power, resulting from use of 99-inch drivers in place of 63-inch drivers for speed of 55 miles an hour.		
6-inch cut-off.....	Gain.....2.9 per cent	
8-inch cut-off.....	Loss.....1.4 per cent	
Decrease in Steam Consumption resulting from use of 99-inch drivers in place of 63-inch drivers for speed of 55 miles an hour.		
6-inch cut-off.....	12 per cent	
8-inch cut-off.....	18 per cent	
Decrease in Coal Consumption resulting from the use of 99-inch drivers in place of 63-inch drivers for speed of 55 miles an hour.		
6-inch cut-off.....	18 per cent	
8-inch cut-off.....	23 per cent	

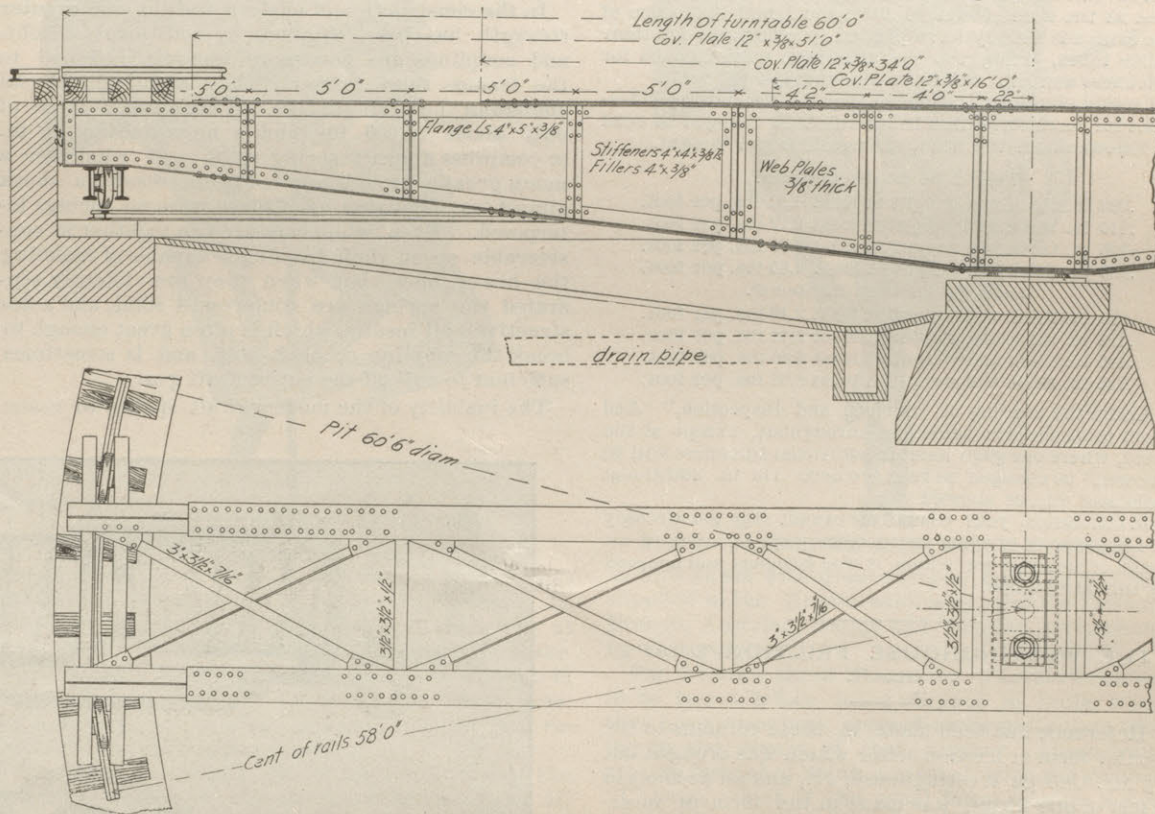
cured at low speed. These are matters which emphasize the other side of the question, a discussion of which does not fall within the purpose of the present paper. The observations which have been described are believed to be correct. If the argument based upon these is not at fault, it is clear that the field presented is one which invites careful study and experiment. It is to be noticed in this connection that during the last few years locomotives have been given wheels which while yet too small for highest efficiency at the rates of speed at which locomotives are driven are much larger than those formerly used; all of these large-wheeled engines have proved very economical in the use of water and coal. These results from the road serve to strengthen the conclusions which are based upon the work of the laboratory.

STANDARD 60-FOOT TURNTABLE—PHOENIX IRON WORKS CO.

The principal features of the construction of the standard sixty-foot turntable manufactured by the Phoenix Iron Works Co., of Cleveland, Ohio, are shown in the accompanying illustration which has been prepared from drawings recently received from that concern. It will be seen that the construction employs a pair of plate girders suitably held at the ends and at the center and braced laterally by struts formed of diagonals composed of $3\frac{1}{2} \times 3\frac{1}{2} \times \frac{1}{2}$ in. angles riveted to corner plates which are in turn secured to the vertical stiffening angles. The web plates of the girders are $\frac{3}{8}$ in. in thickness with $4 \times 5 \times \frac{3}{8}$ in. flange angles. The fillers are $4 \times \frac{3}{8}$ in. and the stiffening T's are $4 \times 4 \times \frac{3}{8}$ in. which divide the outer portion of the girders into 5 ft. panels. The

panel at the center is 44 in. long, those next to the center are 4 ft. in length and the second panels from the center upon each side are 4 ft. 2 in. long. The cover plates, of which there are three upon the top and bottom chords of each girder, are 12 in. wide by $\frac{3}{8}$ in. thick. They are respectively 51 ft., 34 ft., and 16 ft. long for each girder and of the same length for the bottom as for the top chords.

The lateral bracing shown in the plan view, is by means of $3 \times 3\frac{1}{2} \times \frac{1}{8}$ in. angles attached by gussets to the chords. The weight is carried to the center by a bolster composed of 24 in. I-beams secured to the webs of the main girders by means of heavy angle plates, and the construction of the center itself is clearly indicated in the sectional view. The diameter of the middle foundation is 5 ft., and the diameter of the pit is 60 ft. 6 in. The length of the



SIXTY FOOT TURNTABLE BY THE PHOENIX IRON WORKS CO.—FIG. 1.—ELEVATION AND PLAN.

turntable proper is 60 ft. with a radius of the rails of 58 ft. The height of the girders at the center is 4 ft. 9 in. and at the outer ends the height is 24 in. The lower chord between the center panel and a point about 24 in. from the ends being inclined upwards, and the horizontal portion at the ends provides a seat for the I beams which carry the rollers. The construction of this turntable is seen to be simple and strong and from the design of the pivot it is evident that it should work freely. It is understood

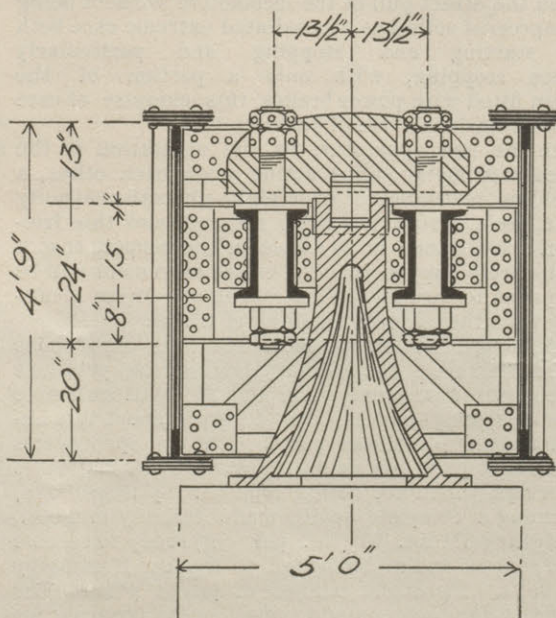


FIG. 2.—SECTION AT CENTER OF TABLE.

that the turntables which have been built from this design have given excellent satisfaction in this and other respects.

Interstate Commerce Commission.

The Interstate Commerce Commission in an opinion by Commissioner Knapp, has announced its decision of two cases brought by the Lynchburg Board of Trade against the Old Dominion Steamship Company, the Merchants and Miners Steamship Company, the Norfolk & Western Railroad Company and

the East Tennessee, Virginia & Georgia, now Southern Railway Company.

The commission rules as follows:

Under the fourth section of the act to regulate commerce a carrier is not justified in charging more for the shorter than for the longer distance by competition at the longer distance point of other carriers which are themselves subject to that act, in the absence of authority from the commission under the proviso clause of said section. Trammell vs. Clyde S. S. Co. (Georgia R. Commission Case, 5 I. C. C. Rep. 324, 4 Inters. Com. Rep. 120, cited and reaffirmed.)

When rates are relatively unjust so that undue preference is afforded to one locality or undue prejudice results to another, the law is violated and its penalties incurred, although the higher rate is not

in itself excessive, and such rule is especially applicable where a given relation in rates, long continued and concededly equitable, is suddenly and almost completely reversed, merely because other carriers to the longer distance point have disregarded their legal duties.

During the period between May 29 and August 1, 1894, when greatly reduced rates were charged by defendants to Knoxville, Tenn., dealers at Lynchburg, Va., an intermediate locality, were entitled to rates over the defendant lines from New York, Providence and Boston not greater than those accepted at the same time on like traffic over said lines to Knoxville, and the excess paid for transportation by the intervening Lynchburg dealers over contemporaneous rates to Knoxville was unlawfully collected. Reparation is ordered accordingly.

STANDARD SIZE OF BOILER TUBES.*

Your Committee "To Adjust Dimensions of Standard Sizes of Tubes to Agree with Recommendations of Standard of Gages for Sheet Metal Tubes, etc.," addressed the following letter to the leading makers of locomotive boiler tubes:

"At the meeting of the American Railway Master Mechanics' Association, held at Alexandria Bay, in June last, standard specifications for boiler tubes were adopted, and the dimensions for thickness given in accordance with the Birmingham wire gage. At the same meeting a standard decimal notched gage was adopted, which it is desirable should be used as far as possible in ordering sheet metals, tubes, etc.

"I have been appointed by President R. C. Blackall a committee to report at the next meeting of the Association 'to harmonize standards, to adjust dimensions on standard sizes of tubes to agree with standard gage for sheet metals, tubes, etc.

"The Birmingham gage numbers used in the standard for boiler tubes are No. 10, No. 11, No. 12 and No. 13, and the decimal equivalents for these are .134", .120", .109" and .095". As the first three of these dimensions are not on the standard gage, I propose to recommend that they be changed to read .135", .125", .110" and .095", these being the nearest dimensions on the Standard Gage to those given in the standard for boiler tubes. The standard specifications also state that 'the tubes must be of uniform thickness

*Report of committee of the Master Mechanics' Association at Saratoga.

throughout, except at the weld, where one gage number additional thickness will be allowed." I propose to recommend a change in this, to read, "where .010" additional thickness will be allowed."

"Before making these recommendations it is desirable that I ascertain if they meet the approval of the manufacturers. I would be pleased to hear from you at your convenience, and if there are any objections, please state them.

Yours truly,

WM. SWANSTON.

Of the manufacturers addressed one only objects to the change from the Birmingham to the decimal gage; all of the others approve the change, if adopted by railroads and locomotive builders in ordering tubes. The prevailing opinion, however, seems to be that .010" is not enough additional allowance at the weld, and ask that .015" be recommended. I also wrote to a number of the members of this association, and they approved the recommendation; but several thought that the allowance of additional thickness at the weld should be .015", and I find that some of the railroads already have printed specifications for their boiler tubes, giving the decimals here recommended for thickness and .015" additional thickness at the weld.

I would therefore recommend that the standard specifications for locomotive iron boiler tubes be changed to read as follows under the head, "Dimensions and Weight."

Tubes 2 in. Outside Diameter.

.095 in. thick and weight at least 1.91 lbs. per foot.

.110 in. thick and weight at least 2.19 lbs. per foot.

.125 in. thick and weight at least 2.97 lbs. per foot.

.135 in. thick and weight at least 2.65 lbs. per foot.

Tubes 2½ in. Outside Diameter.

.095 in. thick and weight at least 2.16 lbs. per foot.

.110 in. thick and weight at least 2.48 lbs. per foot.

.125 in. thick and weight at least 2.89 lbs. per foot.

.135 in. thick and weight at least 3.01 lbs. per foot.

Under the heading of "Surface and Inspection," "And must be of uniform thickness throughout, except at the weld, where one gage number additional thickness will be allowed" be changed to read "where .015 in. additional thickness will be allowed."

In conclusion, your committee cannot urge too strongly the importance of using the decimal gage in ordering all kinds of material for which it was designed and adopted by this association.

THE WESTINGHOUSE FRICTION DRAFT GEAR.

Reference has been made in these columns to the earlier form of friction buffer which was brought out by Mr. George Westinghouse, Jr., and an account of a test of one which was made in the form of interlocking sets of thin plates was given in the RAILWAY REVIEW of January 26, 1893. This idea has been preserved and the construction improved upon and a new design presented which is illustrated herewith.

The accompanying illustration shows the construction and the principles of operation of this buffer and the following, taken from a statement by Mr. Westinghouse, gives a general idea of the steps which led up to the design shown:

Breakages of couplings on long trains during brake experiments in Europe in 1878 and 1879 led to investigations into the causes of this trouble and the seeking for a remedy.

It was found that such breakages was largely due to the great strains produced by the reaction of the buffer springs which had been fully compressed by the brakes first acting upon the front vehicles.

The remedy that suggested itself was to apply some sort of braking device to the buffer rods to overcome the violent reactions, but no attempt was made to put this idea into practical shape until after the 1887 Burlington brake trials, during which violent shocks had resulted from the rear cars closing up with great force against those in front on account of the brakes first acting on the front cars.

Tests made at Burlington by running one empty car against others standing, showed that the adjacent draw or buffer springs were compressed solid when the car struck at a speed of about 3 miles per hour; that there was no shock when these springs were not compressed solid, but that there was a severe shock if the speed were five or six miles per hour.

With the first form of quick action triple valve on a train of fifty cars there was a difference of about five seconds between the first and last cars in setting the brakes with full pressure, and this loss had the effect of creating a difference of speed between the front and rear cars (when the train was stretched) of from eight to ten miles per hour; and as the tests with the one car indicated, a severe shock was a certainty because the buffer springs were too weak to absorb the momentum of the cars due to such a difference in speed.

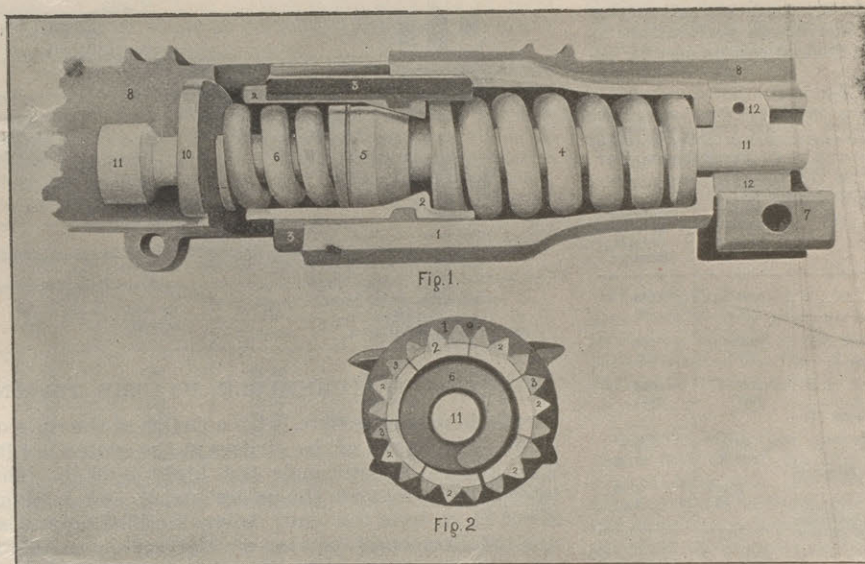
On several occasions during the Burlington brake trials the coupling between the engine and train was

broken by the shock caused by the engine shooting forward on account of the brake force being inadequate to overcome the reaction of the buffer springs, and this difficulty was especially noticeable with the train fitted with extra buffer springs.

In further illustration of the destructive effects of the reactive force of buffer springs may be cited an incident during the government brake trials in 1874 at Newark, England, where the Midland Railway train was fitted with triple valves which effected the release of the brakes in a part of a second. In making a stop while backing all the buffers were fully compressed when the train came to rest. Upon releasing the brakes a few seconds later the passengers received a severe shock, due to the violent reaction of the buffer springs, the force of which was sufficient to break a sound coupling.

In the construction of modern freight cars greater strength has been obtained by additional weight, and couplings are now more securely fastened to the frames than formerly, but without material change in the draft springs. It requires a force of only about 20,000 lbs. and a movement of 1½ in. to compress a draft spring solid, and whenever a much greater force is applied there results a shock almost as damaging as if there were no springs interposed. Even when cars are run together at considerable speed their framing is capable of resisting the heavy blow, but when they are violently separated the springs are compressed solid, and a destructive pull results, which is often great enough to break the coupling or draft bolt, and is sometimes sufficient to pull off the entire draft gear.

The inability of the modern draft spring to resist



WESTINGHOUSE FRICTION DRAFT GEAR.

even the direct pull of the locomotive without being compressed solid has necessitated extreme care both in starting and stopping and particularly when stopping, with only a portion of the train fitted with power brakes, this exercise of care often occasions a loss of valuable time.

In the new apparatus, by the utilization of the friction of metal strips acting upon each other, a yielding resistance of over eight times the capacity of a draft spring has been secured, and this frictional resistance is so ample for the purpose that it will rarely happen that the entire movement will be required to care for the extraordinary forces resulting from the careless handling of trains.

Although the new device offers over eight times the resistance of the ordinary draft spring, yet there are required only one main and 22 small malleable castings, weighing 100 lbs., to bring about this important result. These parts, with two springs and the buffer plate, are enclosed between two malleable castings, which are bolted together by three bolts, forming a complete device made entirely of metal, weighing 331 lbs. (662 lbs. per car) ready to receive the coupler and to be bolted to the car framing by 12 bolts. The entire number of pieces per car has notwithstanding the additional ones required for the frictional resistance, been reduced to 140, weighing 753 lbs., as against an average of over 300 pieces, as shown by a comparison of the practice of 11 roads, and 180 for the latest form of Graham rigging, as applied on the Pennsylvania Railroad.

For the purpose of determining the beneficial effect of the increased draft gear resistance, a train of 40 cars fitted with this apparatus and with quick action brakes, was thoroughly tested in the summer of 1895, by making a series of stops from 20 miles per hour; the first test being made with all the brakes in operation, the second with the brakes on the last two

cars cut out, the third with the brakes on the last four cars cut out, and so on; a "slideometer" being used in the last car, as at the Burlington brake trials, for noting the effect. Brakes were used upon all of the wheels of the engine, and the retardation of the engine brakes was, therefore, above the average.

In each test the brakes were suddenly applied with full force while the train was stretched, and in no case was the movement of the slideometer greater than 20 in., this movement occurring when the brakes were out of action on the rear third of the train. The total resistance of the buffers when these tests were made was about 80,000 lbs., and the results indicated that a total resistance of 100,000 lbs. or more for each buffer would almost eliminate the movement of the slideometer, whatever might be the length of the train, and irrespective of the number of cars acted upon by brakes.

After the tests above referred to, the apparatus was removed from the cars, and further careful experiments were made which have resulted in increasing the total resistance to 100,000-120,000 lbs., and it is proposed to fit these improved buffers to a train of coke cars of the Frick Coke Co., so that numerous tests can be made in daily traffic, the results of which should be of more than ordinary importance, especially in view of the great care now required in the management of long trains, when the brakes are in operation upon the engine and but a few of the cars in front.

Figure 1 is a sectional view of the spring and frictional parts, and Fig. 2 is an end view. A main cylinder, 1, has projecting inwardly 21 "V" shaped friction strips "a" cast therewith. Fitting loosely within the cylinder is a main spring 4, and seven segments 2, each segment having cast with it one "V" shape friction strip, and carrying in a suitable recess two separate castings 3, making three friction strips to each segment. The seven segments and their strips are placed within the cylinder against the main spring 4. A taper wedge-block 5 is inserted between the segments, upon which bears a preliminary spring 6, projecting about ¼ inch beyond the segments 2. Interposed between this spring and the coupler is a buffer plate 10. A tail bolt 11

has a key 12 (or preferably a nut), which is held in its place by a block 7, bolted between the two cast malleable iron side pieces 8 and 9. These side pieces contain two shoulders, between which the end of the cylinder, acting as the equivalent of one buffer plate, and the buffer plate 10, bear as in ordinary practice.

The operation is as follows: When pressure is exerted upon the draw bar, the buffer plate 10 is moved so as to compress the spring 6, which, acting upon the wedge-block 5, forces the segments with their friction strips outward with great pressure against the corresponding friction strips of the main cylinder. When the buffer plate 10 comes against the segments 2, a pressure of about 12,000 lbs. has been exerted upon the wedge-block. Further movement, therefore, is resisted by the main spring 4 and the friction between the movable segments 2 and their strips sliding between those of the cylinder 1. The spring 4 has a total compression of 1½ in., and its resistance, coupled with the friction produced between the strips, increases so that a total force of over 100,000 lbs. is required to fully compress the spring 4.

When force is removed from the coupler, the main spring 4 expands and pushes all of the parts into their normal positions, but in returning to their positions more or less friction is maintained between the strips, on account of the resistance of the wedge-block 5 having the effect of keeping both sets of friction strips in contact with a force depending upon the compression of the preliminary spring.

As the results of many experiments, a proper angle has been determined for the wedge block, and between the strips, so that under no circumstances can these parts lock together and thus prevent the return of the parts to their normal positions.

When tension is applied to the draw-bar the action is substantially the same. The buffer plate 10

rests against the shoulders in the side pieces 8 and 9, and the cylinder 1 and spring 4 are closed upon the other parts, producing the effect already described, thus requiring a pull of over 100,000 lbs. to compress the spring 4.

A central draft pin is used because a careful consideration shows it to be preferable to the strap for this form of buffer, for the reason that any of the parts described, if damaged, can be speedily replaced. Provision has, however, been made for the use of a draft pin of $2\frac{1}{2}$ in. in diameter instead of the one of 2 in. ordinarily used, it being a matter of but small expense to enlarge the existing couplers so as to take a draft pin of the increased dimensions.

For the purpose of testing for the wear between the frictional parts of the apparatus, a machine was specially constructed capable of effecting the total movement of these parts many times per hour, and repeated endurance tests have shown that the apparatus will have long life in daily service.

No lubrication of any kind is required; in fact, the absence of lubrication ensures great resistance between the moving strips and those cast with the cylinder.

The force required to fully overcome the preliminary spring is 12,000 lbs., and to effect a further movement of $\frac{1}{2}$ in., 45,000 lbs., and to effect the entire movement, requires a maximum force of 120,000 lbs.

THE TEMPERLEY TRANSPORTER.

The Temperley transporter which is illustrated herewith is a new form of hoisting and conveying apparatus, invented by Joseph Temperley of London, Eng., the exclusive American rights in which have recently been acquired by the Lidgerwood Manufacturing Co., of New York City. The transporter employs an I-shaped beam for a trackway, along which the load hoisted is conveyed in either direction to destination by a carriage. The beam is suspended horizontally or at a slight incline, and is provided with a series of stops along its bottom flange at any of which the carriage may be arrested and the load raised or lowered. These stops may be set as near one another as desired; five feet is the usual practice. The beam or trackway may be of any length and arranged together with its supports, in a variety of ways to suit circumstances.

A special feature of the Temperley transporter is the novel form of traveling carriage employed, two views of which are shown in Figs. 1 and 2. It consists of two steel side plates carrying four wheels, by which it travels back and forth on the beam, also the hoisting rope pulley and the disengaging and carrying apparatus are of interest. Two cams, one simple, the other compound, are so arranged that the former prevents the disengaging portion of the carriage from releasing the load while it is being transported along the beam, and the latter prevents the movement of the carriage along the beam while the load is being raised or lowered. These cams are so fitted that only one of them can perform its function at a time. The movement of the compound cam is effected by means of a toggle which engages with the stops on the beam and the movement of the single cam is effected by the movement of the suspender or hook which carries the load, all operations of the transporter being effected by one working rope.

Starting with the carriage at the foot of the inclined beam and drawing in the single rope the load is hoisted vertically to the carriage. The ball on the rope operates to rotate the suspender hook until it is in a condition to suspend the load. The upper part of the suspender operates a pair of cams, whose movements are interlocking. The instant after the suspender hook is in a safe position under the ball the cams move, releasing the carriage from the beam.

A further inhauling motion on the hoisting rope carries the carriage up past the various stops. When it is desired to lower at a particular stop it is only required that that stop shall be passed, and the rope then paid out, when the carriage will fall until it reaches the stop, into which it will be locked, and the load released from the carriage and lowered. After delivering this load, or receiving one, as the case may be, the rope is again hauled in, the same action gone through with and the carriage is in a position to pass down all the various stops in its path.

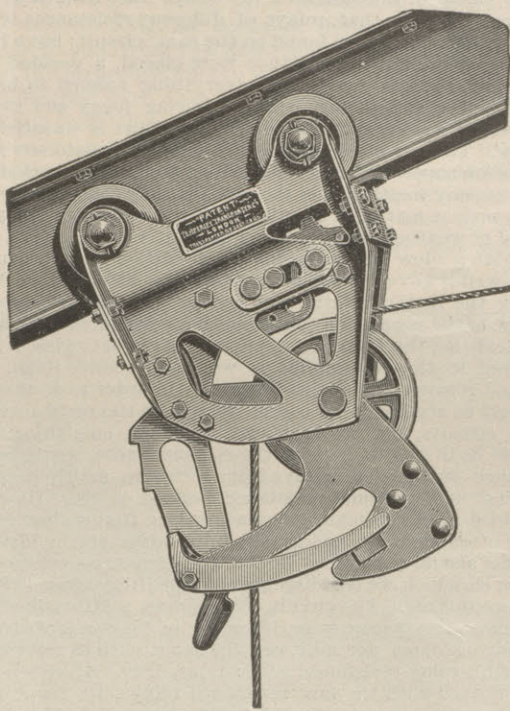


FIG. 1.—CARRIAGE IN HOISTING POSITION.

When the carriage reaches the last stop on the beams the load is detached, and it is free to descend. If, however, it is desired to have the carriage stop at any intermediate point it is only necessary that the stop be passed and the carriage hauled up enough in an upward direction to pass the stop, then, by lowering, the carriage is fixed, and the load released at that particular point.

The beam is usually set at an angle so that the carriage travels in one direction by gravity. If, however, circumstances do not admit of the use of the incline beam a counterweight rope is attached to the rear of the carriage and the carriage is pulled back by the falling counterweight. Fig. 1 shows the carriage locked to the suspended beam and the load

being raised or lowered. Fig. 2 shows the load locked to the carriage, which is free to travel along the beam in either direction. The great outreach of the transporter makes it particularly well suited for work along rivers where wharves are not provided. It has been put to a number of uses in England, notably for handling coal both on wharves and vessels, also for stacking timber, discharging cargo, handling ice, coke, baled hay and cotton, and many other kinds of material, which are conveniently handled in packages. It has also been used for coaling war-

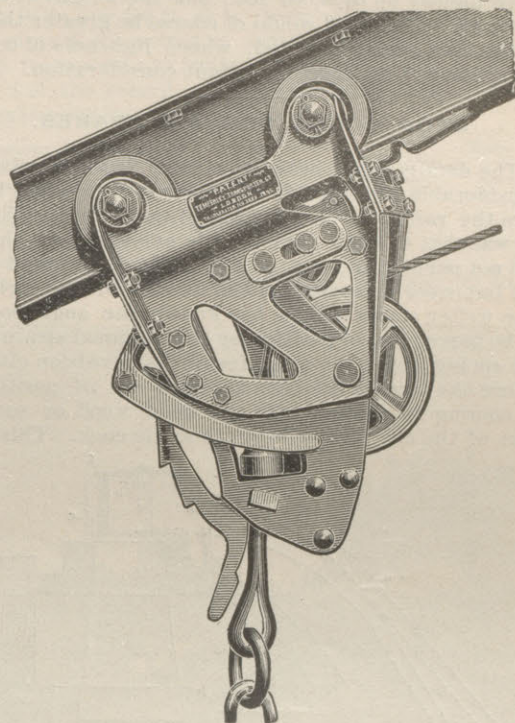


FIG. 2.—CARRIAGES CONVEYING POSITION.

in hips at sea with great success, many having been supplied to the British admiralty, also the German, French, Austrian, Italian and Russian governments for that purpose.

Fig. 3 shows three Temperley transporters about to be tested before being shipped to India, where they have since been erected on large lighters trading on the rivers of that country. These transporters instead of being provided with the common "I" beam which is the usual form, employ a steel tube with a trackway secured underneath, which answers the same purpose. The lighters upon which these transporters are used, carry up to about 1,200 tons of cargo, and have to load and unload at many places where there are no proper jetties or wharves.

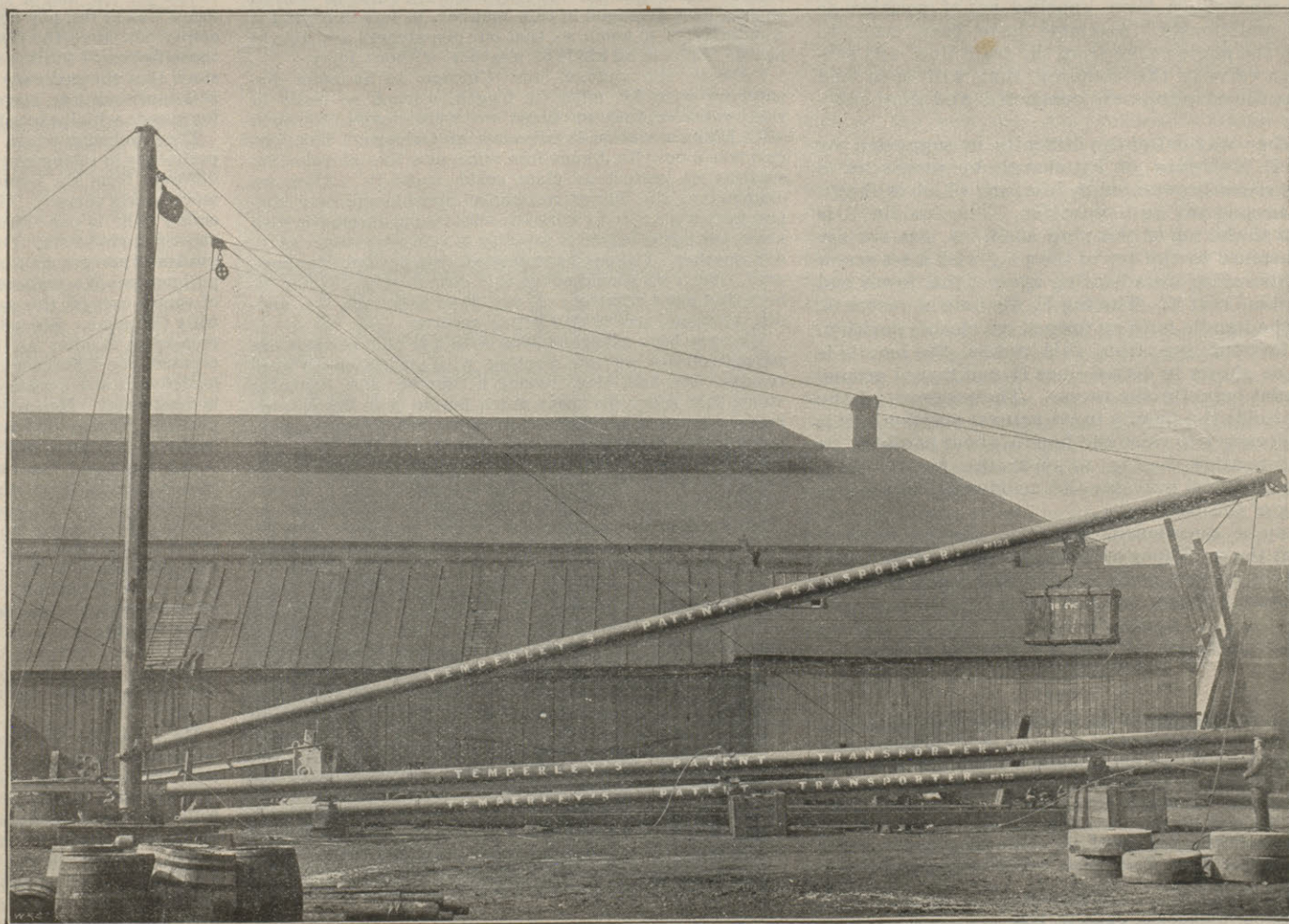
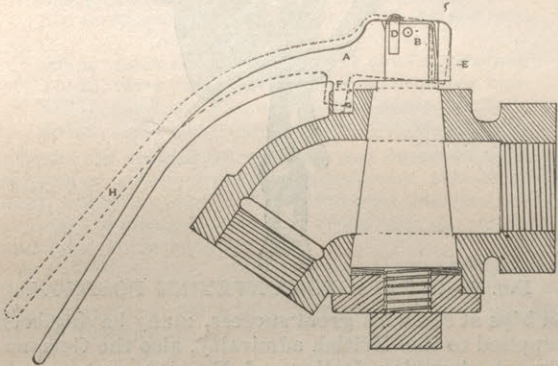


FIG. 3.—TEMPERLEY TRANSPORTER WITH TUBULAR STEEL BOOMS.

The long reach of the transporters enables the cargo to be safely landed on or loaded from the banks which are sometimes 20 ft. above the water level. To enable the apparatus to pass under railroad bridges, etc., it is arranged when not in use to lie flat down on the awning deck. The transporters shown are 63 ft. long and do not exceed one ton in weight. They are worked by a single rope led to the steam winch of a tug boat accompanying the lighters. Tubular transporters of this description can be made to lift conveniently up to 3,000 lbs., but the weight of the boom for such a load would of course be greater than in the case here illustrated, where lightness of construction was the most important consideration.

STOP COCKS FOR AIR BRAKES.

The details of air brake apparatus have received considerable attention in the recent discussions before the railway clubs, and one of the subjects taken up was that of angle cocks. It is evident that they are not perfect and one of the difficulties found is the improper treatment of the handles of the cocks. One writer states that he has known the angle cock to be moved out of position by the torsional strain of the spring under the plug. Instances have been cited where the handle has been knocked out of position by coming in contact with the dead wood or some part of the car located near the angle cock. This is



A NEW AIR BRAKE COCK.

caused by imperfect application of the train pipe at that point. Other instances are given where the handle has been knocked out of position by coal or some other substance falling from the tender, or platform of the car and knocking it open or closed as the case may be. That the handles have been misplaced maliciously is not beyond question, if the evidence of trainmen and others who had charge of the operation of the air brakes is given credence. Careless employees are not free from imperfection in this way, and if charged with neglecting duty by not knowing if the train line is in perfect order, they will often reply that they left it in good order and that it must have been knocked out of position or moved maliciously. Attempts have been made to abolish the angle cocks from the train line, and substitute a valve in the coupling that will open and close as the couplings are connected and disconnected.

Another way out of the difficulty is suggested by Mr. J. D. McIlwain of Pittsburgh by means of a handle recently patented by him, and which is shown in the accompanying illustration. The handle A is pivoted to the top of the plug at B. A flat spring, C, is fastened to the top of the plug with a set screw D. This spring has a bearing against the lower end of the handle at E. The lug F, fits into a recess G, when the handle is in an opened or closed position. To relieve the lug from this recess, the handle is raised as shown in dotted lines H, and moved around to a point opposite the recess. The pressure of the spring holds the handle in its natural position. It is only necessary to raise the handle about one inch at the end to allow the lug to clear the recess. It is very simple and prevents the accidental opening or closing of the cock.

It may be questioned, however, whether it will prevent the malicious opening or closing of the angle or cut out cocks though it will render such performances more difficult.

REDUCTION OF RELAY RESISTANCE.*

U. J. FRY.

During the last decade the wonderful electrical developments have so engaged the attention of all to such an extent that improvements in telegraph machinery have been quite forgotten, or it has been thought that there was no necessity for further development or improvement. While this may be the case, to a greater or less degree, with those having charge of the operation, the construction department has been busy bettering the condition of

its lines, and has accomplished a great deal, but other conditions are not just what they should be.

There has been much change in instruments, especially in the relays. The first relay the writer ever used was a 150-ohm instrument. Later, when engaged on another road, the resistance was found to be 225, 350, 400 and 500 ohms; 400, I believe, was considered the standard, and thought to be about the proper thing. The superintendent of the latter road referred to has recently made a radical change in the standard of his instruments. I presume you will hear from him on the subject later.

Just before the writer came to the road on which he is now engaged, the standard for relays was changed to 150 ohms. Prior to that, relays of different resistances from 100 to 350 ohms, were found on the same circuit; but when relays of uniform resistance were placed, a decided improvement was noted, and everything seemed to have reached a satisfactory state. During foggy and rainy weather, however, this condition of affairs is unsatisfactory. The numerous requests from train dispatchers and division superintendents for wires which will work during stormy weather, and the fact that any delay to a train is a serious matter, a circuit which will work through any kind of weather has become an imperative necessity.

With a view of improving the condition of the wires, the writer gave the subject considerable attention, looked over the lines carefully, and finding the insulation good, came to the conclusion that something else must be done.

Realizing the detrimental effect of large batteries, it occurred to the writer that, if we could reduce them, we would remove part of the difficulty. In order to do this it would be necessary, of course to reduce the resistance of our circuits, and we concluded that the only thing we could do in this line, under the circumstances, would be to change our present relays from series to multiple, thus giving us $37\frac{1}{2}$ ohms' resistance, instead of 150. Having decided upon this plan, and remembering that we had read and often heard it said that the resistance of the instruments should not exceed that of the circuit, we selected a wire on which we could secure this condition after having changed them. The circuit chosen was a Milwaukee to Oshkosh No. 8 gage wire, 104 miles in length, measuring about 15 ohms per mile, or 1,500 ohms, with 35 relays in circuit; relay resistance, 5,270; total, 6,810. After replacing the old with the low resistance relays, we found the total resistance to be 2,872, a difference of 3,938, or the amount of relay resistance taken out. We then reduced our batteries from 150 to 75 cells. After working this wire for six months in this way, we noted the following comparisons: Prior to the change, the wire did not work in the best of weather satisfactorily, and in foggy and rainy weather very unsatisfactorily, and at times we were unable to work more than half way. The current in bad weather fluctuated so that it was impossible for the operators to keep their instruments adjusted. After the change the wire worked perfectly in any kind of weather.

This perfect condition has not been secured on all our circuits, because the conditions are not exactly the same. We have seven circuits arranged in this manner. We are doing business right along irrespective of the condition of the weather. One of our circuits, 200 miles in length, equipped with this class of instruments, did not at first give us the desired results, and we were considerably annoyed in bad weather. We placed a 50 cell battery in the middle of this wire, which resulted in a decided improvement. While this circuit may not work quite as well as shorter ones arranged in this manner, it has improved it wonderfully; so much so, that our dispatchers are able to handle trains in all kinds of weather, without delay.

Prior to the change, our Chicago to Savanna dispatchers' wire, 138 miles in length, worked so badly in rainy weather, that at times we were unable to work with Elgin, a station 35 miles out of Chicago. This circuit was a new No. 8 gage iron wire, new line of poles, insulation as perfect as glass could make it. After we changed to the lower resistance instruments, our dispatchers were able to work the wire its entire length with about the same degree of rapidity in rainy weather as in dry weather. Without having tried, it is our opinion, however, that if we should equip this circuit with 25 ohm relays, and place a battery of, say, 30 to 50 cells in the middle, we would secure still better results.

We have been experimenting with a 25 ohm relay on one 200 mile circuit, and are meeting with exceptionally good results. We find that during a thunder and lightning storm this relay performs much better than the 150 ohm relay. When it is affected by lightning it discharges so quickly that it obliterates only a letter or two instead of a word or two, as is the case with the old instrument. We expect to equip the entire circuit with 25 ohm relays in the near future. We do not wish to be understood as claiming that 25 ohms is the proper resistance; but we have met with such encouraging results that we are going to give them a trial.

Do the railway telegraph superintendents realize their relations to the telegraph fully? After having constructed a line, the telegraph company turns it over to the railway superintendent, and expects him to keep it in repairs. On the other hand, the railway company expects him to do the same. Whenever there are any interruptions of a serious nature the railway superintendent is expected to look after and remove the trouble.

When we look the matter fully in the face we can not but think that all look to the railway superintendent for a good condition of the telegraph. In view of our relation to the system, does it not occur to you that the railway superintendents should have a voice in the matter of equipping the circuits upon their respective roads, more especially those set aside for the exclusive use of the railway company? If it appears that it should we would ask the members present, Are you satisfied with the working condition of your lines? Do your wires work well in all

kinds of weather? If not, do you not think that if a better condition could be secured we owe it to the companies by which we are employed to secure in some manner that which will put them in a better condition, or in a condition to work at any and all times? Do we realize fully what the delay to traffic costs the railway company?

Would it not be pleasant if we could realize that our telegraph system was in a condition to work well at all times? Can such a condition be secured? If so, how and by whom?

Are there any more interested in this matter than we? Will the members of the association start the inauguration of a new era for the telegraph?

LOCOMOTIVE RATING AND FUEL.

In the discussion of the paper read before the Western Railway Club by Mr. Tracy Lyon entitled "Locomotive Rating and Fuel," which was published in abstract in the RAILWAY REVIEW of May 30, Mr. Wm. Forsyth, mechanical engineer of the Chicago, Burlington & Quincy Railroad, contributed the following:

I regard this paper of Mr. Lyon's as one of the most useful of all that have been presented to the club during this year. It is really a complete treatise upon the subject of rating locomotives, and I should think that any road, that wanted to take up the tonnage basis, would find it the best general book of instructions they could obtain on the subject. It deals directly with train resistance and Mr. Lyon says that the calculation of the power of the engine by the ordinary method does not apply very well in rating engines. Neither has the attempt to use a dynamometer car been very successful as applied to this new practice. I had some experience in that direction. When we first went at the rating of engines by the tonnage basis we tried to obtain the difference in resistance of empty cars, partially loaded cars and fully loaded cars, both on grade and on a level, and I have here some figures which we obtained. I may say, first, that it has been considered that the grades were the limiting points on the line, or, rather, that the grades limited the size of the train, but I think that with the increase of speed of freight trains above 30 and 35 miles an hour, that that is no longer the case, that speed is now becoming the limiting element and an engine that can get a long freight train up a one per cent grade, will find equal difficulty in maintaining a speed above 25 miles an hour on a level.

The figures that have been given for train resistance generally have been obtained for short passenger trains, and when you get figures for train resistance for long freight trains it soon becomes apparent how much influence the length of the train has with the resistance. In our experiments on grades, at a speed of ten miles an hour the resistance of long trains and short trains was very nearly the same, that is, the bulk of the resistance was due to the grade, and it showed also that the journal friction was about the same—journal friction and wheel friction, as we might naturally expect, for long trains or short trains. We found on a level at 25 miles an hour the resistance of 59 empty box cars was 20 lbs. per ton and of 30 empty box cars 24 lbs. to the ton. Of 18 loaded stock cars the resistance was 13 lbs. per ton; when one-third loaded it was 19 lbs. per ton, and of those same cars empty the resistance was 21 lbs. per ton. That was also the same for 21 empty box cars—the resistance was 21 lbs. per ton. Now those figures, I think, are very nearly correct, and they show that the ordinary figure which is assumed for train resistance must be largely increased for long trains and for speeds which exceed 25 miles an hour.

The conclusion which we came to as the result of our experiments in rating empty and loaded cars was somewhat different from Mr. Lyons, but it is likely that his figure is more nearly correct. He assumes that the resistance of empty cars is one-third greater than loaded cars, or as eight pounds to six. Our first conclusion was that on grades of one per cent or more when the speed is low, the pull per ton of a train of heavily loaded cars, and a train of empty cars of the same approximate weight is practically the same. Second, on a level, where speed is increased to 25 miles an hour or the wind resistance is increased, the difference in pull per ton of a train of heavily loaded cars and a train of equivalent weight of empty cars is very great. Hence for grades not exceeding one per cent the number of cars for a train of empty or lightly loaded cars is governed by the resistance imposed by speed on a level; while the rating for trains of heavily loaded cars is governed by the ruling grade. As the grade of any division exceeds one per cent the factor of resistance due to grade become more important, while in proportion as the ruling grade amounts to less than one per cent, in that proportion do the other factors of speed and wind become more important. As a preliminary rating for trial we recommended for empty cars to add 50 per cent to their weight; for cars having one-third loading 30 per cent to their weight; cars having two-thirds loading 10 per cent. I am not sure whether these figures will apply directly for engine rating, but relatively they are nearly correct.

Mr. Lyon touches here on the possibility of comparing locomotive performance on different roads, even when you have the figures stated on a ton-mile basis, and he seems to doubt that the figures will, even then, be really on a fully comparative basis. I think that may have some effect on our proposed change in locomotive performance sheets, although it will be admitted we are getting very much nearer the truth than on the old mileage basis. He says, for instance, it would hardly be fair to compare the coal consumed per ton-mile on the Lake Shore with that consumed on the mountain grades of the Union Pacific.

*A paper read before the Association of Railway Telegraph Superintendents, June 17, 1896.

Then Mr. Lyon, in addition to train rating, comes to rating of the engineer and fireman, and shows that, with the more accurate data, he is able to distinguish the good men from the poor, and while he does not believe in the premium system he still has a system of good marks, which the men evidently regard as something valuable. I have often thought that in making those marks, or giving men credit for good work or reproving them for poor work, that they would appreciate the record more if the figures were given in dollars and cents instead of pounds of coal. Mr. Lyon's record shows how much in pounds an engineer burns in excess of what he should have burned. Now if his record would show that an engineer had burned \$15 worth or \$25 worth more coal per month than he should have burned, I think it would appeal more directly to his sense of how much injury or how much good he has done the company, and how much the company appreciated him or depreciated him, or that work.

EMERGENCY BRIDGE CONSTRUCTION ON THE "BIG FOUR" R. R.

During the night of January 31, 1896, a freight wreck occurred at a bridge upon the Chicago division of the Cleveland, Cincinnati, Chicago & St. Louis Railway, near Lawrenceburg Junction, Ind., connected with which were several interesting features, both in regard to the wreck itself and also in the rapidity with which the wreckage was cleared away, a temporary structure built and traffic resumed as well as the replacement of the temporary with a permanent bridge. We are indebted to Mr. Schuyler Hazard, assistant engineer of the road for the following description, and also for the photographs from which the accompanying illustrations were prepared:

Upon leaving Lawrenceburg Junction, west-bound, a heavy grade is encountered, and, after arriving at the summit, a heavy down grade leads to the first crossing of Tanner's creek. This crossing is made by means of a through iron truss bridge of 160 ft. span, and at an elevation of about 52 ft. above the bed of the stream. This creek carries a large amount of water at times, as it drains a large area of very hilly country, and, consequently gets its water rapidly in case of heavy rainfall. On account of being somewhat contracted in parts, the water frequently rises rapidly, and crossing at a somewhat high level is therefore necessary which requires the use of the through span truss. On the down grade mentioned, and before arriving at the bridge, is a curve to the right. The accident occurred to a freight train, bound-west, consisting of one of the largest freight engines in the service, followed by 33 cars and a caboose, the first 15 of which were loaded. This train left Lawrenceburg Junction about 10 o'clock p. m., and when rounding the curve and about 2,000 ft. from the bridge, the second car from the engine, loaded with coke, jumped the track and followed along the ties, passing over one switch, trailing, and through and over two pit cattle guards. By the time the bridge was reached this car was far enough away from the track to strike the end post of the bridge which it wrecked, carrying down the whole span, and taking it into the stream below.

Just before reaching the bridge, and when within two or three hundred feet of it, the fireman discovered the car off the track on his side and made this condition of affairs known to the engineman, who, with good judgment and remarkable foresight, opened the throttle, giving the engine more steam and thereby breaking the coupling that attached the derailed car to the car next following the engine. This allowed the engine and one car to go rapidly forward and reach the other end of the bridge which it cleared in time to save the engine and its occupants, consisting of the engineman, firemen, conductor and head brakeman. The remainder of the train piled up in the opening, thus made by the wrecked bridge, until it was practically filled up near the east abutment, leaving one car hanging over the abutment, with one car and the caboose standing on the track. The caboose contained the remainder of the crew. Thus it will be seen that the lives of the entire crew were saved by this distribution of their number and by the length of the train. The derailment was caused by a broken flange which allowed the wheels of the derailed car to climb over the rail.

The wreck as stated occurred at 10 p. m., January 31, and the maintenance of way department immediately set about to assist the wrecking gangs in removing the debris so as to prepare for the building of a temporary structure over the opening. The appearance of the bridge after a portion of the wreck had been cleared away is shown in Fig. 1, which was prepared from a photograph taken February 1. The track was re-located 17 ft. north of the tangent crossing the bridge, parallel with it, and connected at both ends by means of three degree reverse curves. From the east a pile trestle was built, using short piles in

the bank and long ones after reaching the abutment. From the west a framed trestle was built. The work upon the temporary trestles was begun on Saturday afternoon, and completed so as to have a train pass over at about 10 o'clock on the following Tuesday morning. The work was carried on day and night in spite of heavy rains which fell Saturday night and Sunday, the creek rising eight feet in three hours on Sunday night.

After an interruption of eighty-four hours traffic was resumed over the temporary structure which consisted of 6 pile bents each containing four piles, 40, 50 or 60 ft. long, as occasion demanded. These were built out from the abutment on the east side, while the structure for the west side consisted of 5 bents framed with two plumb and two batter posts built out from the west abutment. More time was consumed in building this temporary work than seems necessary, but the delay, if it can be said that there was any, was due to two causes. First: the piles had to be delivered on the west side of the creek, while the pile driver was on the east side. This necessitated hauling these piles across the

on the day shifts and 100 men at night.

Upon the day following the accident communication was opened by telegraph with several of the more important bridge companies asking for estimates of cost and prompt delivery and erection of a suitable span. The Pencoyd bridge department of the A. & P. Roberts Company of Philadelphia, assured prompt delivery and erection within sixty days. This company was given the contract for a through truss span of the following dimensions. One span, single track, through bridge, 7 panels, each 22 ft. 9½ in., or 159 ft. 6½ in. from center to center of end pins; 27 ft., center to center of chord pins, and 16 ft. from center to center of trusses. The following was the record made by the bridge company in carrying out its contract:

Complete data received	Feb. 5
Material ordered	" 5
Drawings completed ready for shops	" 11
Templets finished	" 15
Commenced to put iron into shop	" 17
Shipments began	" 21
Shipments completed	" 23
Time consumed in the manufacture of the bridge, 15 days	



FIG. 1.—APPEARANCE OF WRECKED SPAN AND ABUTMENTS.

opening, after a great deal of handling. Second: the rain was so heavy at times as to almost drive the men away from the work, and the creek rose so as to make the crossing of the stream almost impossible and seriously interfered with the location of the bents in the bed of the stream. In view of these drawbacks the time consumed is very short for the length of span and depth of opening, especially when it is taken into account that several hundred feet of track had to be built including frame and pile trestles in the banks flanking the opening. The force employed upon the temporary structure was 130 men

In a little over three weeks, or to be more exact, 23 days, from the date of the accident, the bridge, weighing a little less than 254,000 lbs., or 127 net tons, was manufactured, loaded and shipped away from the shops of the bridge company. The men at the site of the bridge began work on February 19, 1896, by unloading timber, framing the traveler, erecting the false work, removing part of the wrecked span, and unloading the new bridge.

The bridge was unloaded March 4, 1896; the erection of the new span was commenced March 9; the span was swung March 11: it was slid into position March 13; the floor was put on (work done by railway) March 23, and the first train passed over the new span March 23. Thus it will be seen that 52 days elapsed between the date of the accident and the resumption of traffic over the new span. The span was entirely completed, painted and in use with the slow order removed on March 30, 1896.

The work was begun with eight men and prosecuted with an average of twenty-one men. The time elapsing from date of the accident to the date of entire completion of new span was 59 days, the bridge company coming within its contract limit by several days. The new span was erected 3 ft. off the center lines to allow trains on the temporary track to clear the traveler, as shown in Fig. 2, the distance from the center of the temporary track to the center of the new span in its temporary position being 20 ft. The bridge was built in accordance with the standard bridge specifications of the C., C. & St. L. Ry. Co., of which Mr. Geo. W. Kittredge is chief engineer and Mr. S. Hazard assistant engineer.

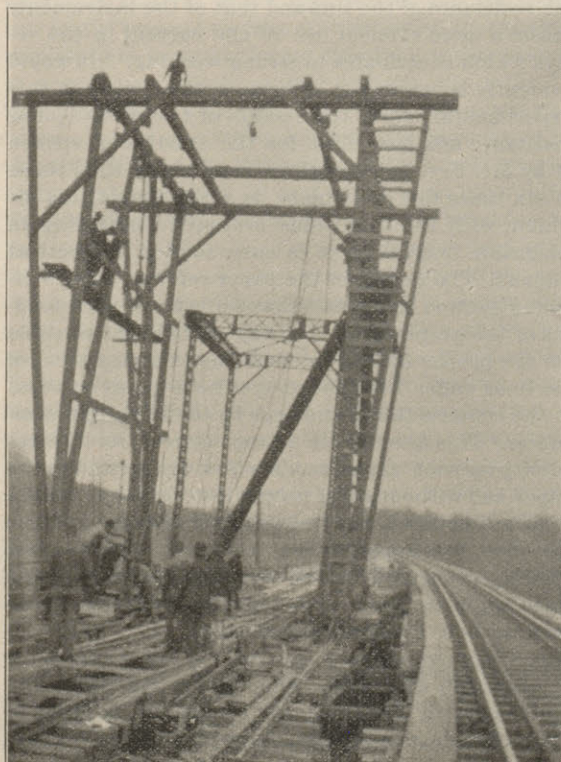


FIG. 2.—SHOWING TRAVELER AND TEMPORARY TRACK.

The fifteenth annual edition of the Official Railway List has appeared for 1896, upon the lines which have long been followed by its publishers, and which are too well known to require special mention. The dimensions and forms of construction of the Master Car Builders' Association, which have for a number of years appeared in the back of the book, have been revised and brought up to date including the changes which have been made prior to the convention of this year. While the typographical work of former editions has been excellent, its appearance this year is especially neat and attractive.

THE RAILWAY REVIEW

OFFICE OF PUBLICATION:

The Rookery, - CHICAGO, ILL.

Eastern Office: 189 Broadway, New York.

TERMS OF SUBSCRIPTION:

Per Year..... \$4.00
 Foreign Subscription (including postage)..... 5.00

Convenient binders sent postpaid for \$1.00.

PUBLISHED EVERY SATURDAY: Subscribers are requested to give information of any irregularity in receiving THE REVIEW.

Rates of advertising made known on application.

All remittances should be by Draft, Express, or Money Order, payable to THE RAILWAY REVIEW.

Address all communications to THE RAILWAY REVIEW, Rookery, Chicago.

CHICAGO, SATURDAY, JULY 11, 1896.

It is quite safe to observe that were the railways to cover their normal requirements in the way of rolling stock and equipment that the iron and steel makers would have very little if any complaint to utter. The iron industry despite all to the contrary is in a vigorous condition. It is quite true that about one-third the possible producing capacity is idle and that in consequence, prices are at a low ebb. Apart from this not unusual condition the industry is in a good condition and it is supported by the hope and prospect that the requirements of the next two months will relieve the present strain. Consumers of coke have clung to the belief that prices would break and that prices of ore might break, but neither have. Quotations on finished products have weakened all around except in structural material, and even in this a shrewd buyer can buy below the cast iron rates. The whole country is waiting for something to happen, and that is the infusion of vitalizing spirit into the market. Patience is necessary because there are obstacles in the way of the hoped for revival of demand. No sudden expansion of demand is probable, but the exasperating economizing process cannot be indefinitely continued.

BECAUSE of the wide spread interest concerning the condition and prospects of the Santa Fe property, no apology is necessary for the space given to the report of the receivers covering the period of their administration, which will be found in this number. This report will stand as a model of receivership operation for many years to come. It is probable that, relatively considered, no road which passed into the hands of the court in such a demoralized condition as the one in question, was ever turned over to a reorganized company on such an improved basis as was the Atchison, Topeka & Santa Fe. It is fortunate that an example of what receivership management should be, has been afforded, so that in the future a guide may be had for the courts when such applications come before them. Friendly receiverships, by which is meant the appointment as receiver of the same individuals who have made a receivership necessary, have been altogether too common in this country. It is true that in the Santa Fe case the initial appointment was of this character, but the resignation of the prime mover gave an opportunity for the appointment of a wholly disinterested party and Mr. Aldace F. Walker was chosen. Although associated with others, the management of the property practically devolved upon him alone, and to him must be given the credit for the splendid showing made.

IN his paper upon locomotive rating and fuel read before the Western Railway Club and which was reproduced in the RAILWAY REVIEW of May 30, of the current volume, Mr. Tracy Lyon touched upon the foundation of successful fuel rating schemes when he said, "Our men are now thoroughly interested in the matter of coal consumption—which is half the battle—and I think feel on the whole an entire confidence in the records. Their work as far as coal is concerned is now considered as one of the most im-

portant factors in their personal records, and it is understood that a continual poor coal record will result in dismissal, or at least a loss of rank." There is no doubt that more can be accomplished by securing the individual interest of the men than in any other way, and it is equally true that the comparison must be perfectly fair in order to be given the confidence of the men without which good records cannot be expected. In this connection the following remark was made by Mr. Ammor before the Northwest Railway Club in considering the same subject, "Engineers and firemen are cognizant of the inaccuracy of performance sheets as they are shown on some roads, and use it to good advantage when called to account for an extravagant use of coal. In such cases it must be admitted that they have the better of the argument. Accuracy in individual engine accounts will prove productive of greater effort by engine crews, and accomplish better results when true and correct records are advertised. The exigencies of the times demand a more correct system of fuel accounts and the saving effected by proper reports will pay for extra clerical force and pay a dividend besides." As to the additional expense due to keeping up these records it is interesting to note that with the very complete system inaugurated by Mr. Lyon on the Chicago Great Western Railway, two additional clerks only are required and occasionally an extra helper at some of the roundhouses where the force is not otherwise sufficient to place the coal properly upon the locomotive tenders. Against this expense Mr. Lyon places a saving of twenty-four per cent in the consumption of coal per 10,000 ton-miles, which renders this clerical work and the extra shoveling very cheap to the road.

ELSEWHERE in this issue will be found a paper upon the subject of relay resistances for railway telegraph lines which was read by Mr. U. J. Fry, superintendent of telegraph of the Chicago, Milwaukee & St. Paul Railway, before the Association of Railway Telegraph Superintendents. The paper records beneficial results from a change from the traditional high resistance line relays to those of much lower resistance, and from a rearrangement of the line batteries so as to place a portion of the power at points intermediate between the terminals. With the relays wound to twenty-five ohms he has greatly improved the service of lines two hundred miles in length, and the working is made better in several different ways. The line battery is cut down which by reducing the voltage decreases the tendency to produce leakage during wet weather, and also the effect of lightning is considerably reduced, as the low total line resistance causes a more rapid discharge of the atmospheric electricity than was possible with the use of high resistance relays in the line. The principle of securing a balance between the resistance of the line and that of the instruments causes a more efficient use of the current in the relays which contributes to strong working. It would evidently be unwise to announce thus early in this experimental work that relays of twenty-five ohms resistance are just right for the conditions spoken of by Mr. Fry, but that these were better than those of six times this resistance is a fair proposition for which, with the conditions ordinarily obtaining in telegraph operation, it is easy to find theoretical support. The author of the paper referred to also directs attention to the fact that while the superintendent of telegraph of a railway is held responsible for the proper operation, and the maintenance of the lines under his charge, yet he is given no voice in the construction of the lines by the telegraph companies. This accounts in a large degree for the necessity for such experiments which are quoted in the paper, and without going deeply into the subject of the relations between the telegraph companies and the railways, it is apparent that the men who are most directly concerned in the working efficiency of the lines might to good advantage be consulted in regard to their original construction. It is only necessary here to compare the railway superintendents of telegraph with those who occupy corresponding positions with the telegraph companies, in order to show that the conditions under which each work, are very different. The matter of correct and prompt working of wires is most important where train

orders are concerned, not only in regard to prompt service, but on account of the grave responsibilities which are involved in the messages of dispatches, and the results of the study which the railway men give to the subject of improving the working of lines during bad weather should be made use of in the original construction of circuits. The improvement suggested by Mr. Fry is so easy of solution, that it should be considered and put into effect without delay, especially as there seems to be no reason why this should not be done.

THE PROPER REMEDY FOR RATE CUTTING.

A railway journal referring to the recent action of the Joint Traffic Association in regard to the effort to be made by that organization to put an end to illegal rate cutting by outside lines through the medium of the courts, says that "The reduction of rates by all the association lines would, of course, be a perfectly legitimate method of fighting the 'Clover Leaf,' and it would seem as though such a combined attack ought to very quickly bring any small or poor road to terms." In other words, it is apparently held that the performance of an illegal act by one road makes legitimate a similar act by another, which is, to say the least, a peculiar position for a public journal to assume. It appears that the "Clover Leaf" (Toledo, St. Louis & Kansas City Railroad) was accused at a meeting of the Joint Traffic Association of cutting the rates on traffic from St. Louis, and upon the recommendation of Mr. Ingalls it was suggested that the attorneys of the association investigate the case, and if the charge could be maintained, commence proceedings against the company for the violation of the act to regulate commerce. It is full time that something of this kind was done. Had such a course been followed since the enactment of the Interstate commerce law the railroad situation of the country to-day would be vastly superior to its present condition. Plenty of excuses for neglecting to thus prosecute a competitor may be urged, but it is doubtful if they will bear examination. Railroad officials are put in charge of railroad properties for the purpose of making money for their owners, and any attack upon the revenue of their company should be resented with as much vigor and as ready a resort to the law as would be a direct robbery of the treasury. There is, of course, a difference in the character of the act in the two cases so far as the offenders are concerned, but there is no difference in the result of the act to the road whose revenues are thus threatened.

The prevailing sentiment that a fellow railroad official should not be proceeded against in law is almost wholly responsible for this lax state of affairs, and it is probable that had the law made the prescribed penalty for its violation attach to the company in the way of a fine rather than to the individual with the possibility of imprisonment, violations would have been of much more infrequent occurrence. But the fact that a duty is distasteful does not relieve one of its obligations. Leniency is an admirable quality but it has little place among railroad officials employed to conduct the affairs of the corporation. A personal offense may be forgiven or condoned, but an offense against a corporation cannot of right be proceeded with upon the same theory.

The offense of rate cutting has been held all too lightly by those entrusted with the management of railways. Nor is there any theory upon which the practice can in any sense be justified. The gravity of the offense lies in its three-fold relation. Primarily it is an offense against the road whose property is thus misused and whose revenue is depleted. Broadly speaking, no road secures any lasting benefit by rate cutting, but on the contrary permanently injures itself. It may for the time being secure an apparent increase in revenue, but the ultimate cost puts the balance on the wrong side of profit and loss account; so that rate cutting invariably defeats the very purpose for which it was inaugurated.

The secondary effect of this practice is the injury inflicted upon other railroads, who are wholly without means of self-defense. The theory that a railroad has power to protect itself against attacks upon its business by a rival is wholly false. It has the power of retaliation, and while that may afford some satisfaction to the individual who is for the time being charged with the conduct of the road, it is

by no means so gratifying to the owners of the property. It is natural for a person who is struck to strike back, but that does not repair the amount of damage, but on the contrary adds to it. The complex nature of the American railroad system makes it impossible to reduce rates on one road without directly affecting the rates upon other roads; so that although there may be an entire absence of intention to do injury on the part of the road that initiates the reduction, that is the inevitable result.

The third and, rightly considered, the most important evil growing out of rate cutting is the effect upon the general public. Stability in rates is a prime requisite for the successful conduct of commercial enterprises. Incidents without number can be cited where the cutting of rates has resulted in the utter destruction of a business venture. Because of the public character of railroad service every man is entitled to stand upon an equal footing with his neighbor. Not many months since a western merchant, relying upon the stability of tariffs which had for a long time been maintained, purchased a supply of nails and barbed wire in anticipation of a heavy demand. He had scarcely more than received them when the rate on these articles was unlawfully reduced netting him a loss of more than ten thousand dollars. Such a thing ought not to be possible, and it is at least questionable if under the law as it stands, a party so aggrieved has not the right of action for damages against the railroad responsible for such a proceeding.

In view of the consequences which are thus seen to attach to an unlawful reduction in rate, it is not surprising that Mr. Ingalls advocates the commencement of legal proceedings against railroads guilty of this offense. It is probably true that no road has during the past few years been altogether guiltless in this respect, but that is no reason why the offense should be longer tolerated. It is to be hoped, therefore, that the case in question will be pressed to a conclusion and the rights of railroads as well as of the public be definitely determined.

AUTOMATIC BRAKES FOR ELEVATED RAILROADS.

In a discussion of the subject of air brakes as applied to elevated railroads which was presented in these columns in February of the current volume, the advantages to be derived from the employment of automatic air brakes were mentioned together with the positions relative to this matter which have been taken by those who prefer what is termed the straight air brake without the automatic feature. It is held by the advocates of straight air that conditions which obtain upon surface roads making it necessary to provide automatic features do not exist upon elevated structures; or in other words that trains are not in danger of breaking in two, and also that it is not as necessary upon elevated roads to provide means for the trainmen to apply the brakes in cases of emergency. It is true that trains are not as likely to break in two on elevated roads, and protection from such occurrences has not been considered important on account of comparative freedom this trouble, and hence the straight air brake has had considerable support among the officers of elevated roads. An accident, however, which recently occurred upon the Lake Street Elevated Railroad in Chicago is likely to effect a radical change of opinion in favor of the automatic air brake of the type which will act in an emergency with the least possible delay. In other words, the lesson which we draw from this casualty is that the safest brake for elevated roads is the automatic quick action, using these terms in the sense of meaning what they say.

The accident referred to consisted of the derailment of the leading wheels of a motor truck under one of the new motor cars with which this road has been equipped for the change from steam to electric traction. The derailment occurred at a switch located upon a curve and which was passed in the trailing direction. The truck for some reason was not displaced far from its normal running position until a second switch in the neighborhood of two hundred feet from the first one was reached, this being also in the trailing direction. At this point the motor car was thrown from the structure to the street, injuring several persons. The coupling between the first and second cars fortunately gave way,

though not until the second car had been pulled partly over the edge of the structure. For some unascertained reason the air brakes had not been applied by the motorman before the motor car left the structure, but they were applied automatically by the separation of the first and second cars upon the breakage of the couplers, and this prevented the second car from being drawn far enough over the edge of the structure to fall into the street. The accident was apparently attributed to the construction of the motor truck, which was of the form illustrated in the RAILWAY REVIEW of February 13 of the current volume, and this led to the ordering of fifty new trucks of the Baldwin Locomotive Works design which was illustrated in the issue of March 7, with which the McGuire trucks are to be replaced. The use of electricity has been abandoned for steam locomotive traction pending the change of the trucks.

We are not specially concerned at this time with the reasons for the derailment, but a better demonstration of the value of the automatic brake could hardly be devised. One of the best features of the automatic principle is its ability to correct the effect of neglect in the operation of brakes, and in this instance it is clear that the brakes would not have been applied had they waited for manual operation. This is incidentally an example showing that the so-called failures of air brake apparatus are often really failures on the part of engine men to apply the brakes. It is stated that there were a number of people in the second car of this train, and had it been dragged over into the street it is safe to say that many of them would have lost their lives. The Lake Street Elevated Railroad had used a vacuum system up to the time of making the change to electric traction, when they put the quick action automatic into operation in connection with compressors driven by motors. When the change was made this type of brake was selected in preference to the straight air form with a view of enhancing the safety of train operation by making it possible for the trainmen to stop the train in cases of emergency, as well as to provide against the serious consequences which might follow from trains breaking in two, and the outcome of this accident shows the wisdom of the decision.

With the introduction of electric traction and the removal of one of the two men who were formerly at the head of each train the necessity for providing against accident to the one in control of the speed of the train has greatly increased, and it is all the more necessary to provide the trainmen with apparatus for stopping trains than when the engine runner has an assistant in the fireman. Enough cases are on record of sudden accident to engine runners to raise the question as to whether it is safe to leave but one man at the head of a train to look after its safety, but with an automatic brake which provides conductor's valves or its equivalents the trainmen can easily prevent serious accidents due to running past stations or unwarranted speed at the approach to terminals, which greatly reduces the risks in this direction. The situation relative to automatic brakes in this connection has already been stated in these columns in the following words: "So long as trains are composed of cars which must be coupled together there will be danger of their breaking in two, and so long as hose connections are used with brakes a broken or open train line may occur, and there is a danger with a non-automatic system that upon the application of the engineer's valve the requisite pressure will not reach the brake shoes. To sum the matter up, the automatic feature combined with the possibility of making an emergency application in case of need, has placed the automatic quick-action brake in such a position that no other system is considered admissible upon surface roads in this country, and as a broad proposition there seems to be no reason why provision of the same degree of safety should not be necessary upon elevated as upon surface roads."

The People's Line of steamers navigating the Hudson river between New York and Albany has just been reinforced by a new vessel which is claimed to be the largest and finest steamboat ever built for river navigation. The vessel, which has been named the "Adirondack," was modeled and designed by John Englis, the vice president of the company owning the

People's Line, and was built at Greenpoint, N. Y., at the yard of John Englis & Son. The keel was laid on June 8, 1895, and the steamer was launched in November. The general dimensions and detailed description of the vessel are as follows: The hull is 412 ft. in length over all and 400 ft. on the water line; 50 ft. beam and 90 ft. wide over guards and 13 ft. deep, and draws 8 ft. of water; 4,500 tons gross and 3,000 tons net measurement, with a freight capacity of 1,000 tons. There are five decks—main, saloon, gallery, upper gallery and dome decks. On these decks are located 350 state-rooms, including 24 parlor rooms, and four suites of parlors and bed-rooms with brass bedsteads. In addition there are 286 berths in the cabins and 120 berths for the crew.

REPORT OF THE RECEIVERS OF THE ATCHISON, TOPEKA & SANTA FE R. R.

Believing that the reorganized Atchison, Topeka & Santa Fe Railway Company, and all persons interested in its securities, will desire to know something of the history of the estate during the two years while its corporate management was suspended, the receivers have caused to be prepared in a condensed and readily intelligible form, a report of the administration of their trust, which is now submitted.

The Atchison receivership was established December 23, 1893, and terminated December 31, 1895, covering a period of two years and eight days. The receivers first appointed were J. W. Reinhart, John J. McCook and J. C. Wilson. Mr. Reinhart resigned about September 1, 1894, and Aldace F. Walker was appointed in his place. Mr. Wilson died in September, 1895.

During its existence the receivers directly controlled the operations of the Atchison, Topeka & Santa Fe Railroad proper, 4,582.12 miles. Indirectly they also controlled the remaining lines of the present Atchison system, including the Gulf, Colorado & Santa Fe, Southern California, Sonora & New Mexico and Arizona Railroad Companies, 1,899.37 miles, making 6,481.49 miles in all; Receiver Walker being president of the corporations which operated the last named lines respectively.

While the foregoing is the mileage of the present Atchison system, the so-called system mileage during the receivership, for which figures will be found below, embraced for a time certain other short branches for which independent receiverships were subsequently created. The same persons were also for a time receivers of the St. Louis & San Francisco, Atlantic & Pacific, and Colorado Midland roads.

The income and expenditures of the receivers of the Atchison, Topeka & Santa Fe (4,582.12 miles as above), during the period from December 23, 1893 to December 31, 1895 inclusive, were as follows:

INCOME.	
Gross earnings.....	\$42,248,912.19
Operating expenses.....	32,976,089.09
Net earnings from operations.....	\$9,272,823.10
Received from A., T. & S. F. R. R. assets:	
Cash and accounts receivable.....	\$2,988,264.50
Fuel, material, supplies, etc.....	1,028,667.90
Other prior assets, (net).....	377,009.43
Received from system lines, G. C. & S. F., So. Cal., N. M. & A., Sonora (net remittances).....	876,224.53
Income from investments (Coal and land companies, etc.).....	594,075.23
Temporary loans from joint executive reorganization committee.....	1,085,951.78
Total to be accounted for.....	\$16,802,956.47
EXPENDITURES.	
Taxes.....	\$2,263,355.30
Rental, tracks and terminals.....	581,460.66
Rental, locomotives and cars.....	62,696.51
Interest and discount.....	146,601.20
Property expenditures:	
Construction, etc.....	\$ 43,861.58
Improvements.....	1,429,827.44
Equipment.....	31,835.16
Profit and loss—Depreciation in material and accounts charged off as worthless.....	47,461.71
Payments for A., T. & S. F. R. R. Co., obligations including pay rolls, vouchers, and accounts prior, western bills payable, claims, and other prior liabilities.....	7,019,396.99
Payment account principal and interest syndicate loan.....	655,769.94
Payments for bonds and coupons:	
Equipment trust series "A" sinking fund.....	750,000.00
Interest on first mortgage bonds.....	739,805.00
Coupons and interest on other securities.....	2,181,281.61
Advances to auxiliary companies (net).....	312,332.17
Contributions to Mojave rental.....	443,412.52
Miscellaneous items paid.....	131,035.08
Sundry items held for future adjustment.....	27,639.00
Total expenditures.....	\$16,866,681.87
Balance of current liabilities in excess of current assets taken over by A., T. & S. F. R. Co.....	63,725.40
Total accounted for.....	\$16,802,956.47
The last above balance comprises the following items, as of December 31, 1895:	
LIABILITIES.	
Vouchers, pay checks and rolls.....	\$2,574,102.14
Sundry accounts payable.....	196,701.71
Notes payable (other than reorganization committee).....	44,000.00
Taxes accrued.....	324,227.16
	\$3,139,031.01

ASSETS.		
Accounts receivable:		
Individuals and companies.....	\$1,341,702.67	
Agents and conductors.....	204,937.20	
Notes receivable.....	60,334.33	
Cash and cash items.....	338,713.68	
Advances to A. & P. Equipment Co. (since paid).....	115,130.04	
Miscellaneous.....	9,529.44	
Insurance premiums paid, not yet charged to expenses.....	57,424.34	
Fuel, material and supplies.....	947,333.91	\$3,075,305.1
Balance current liabilities receivers' only.....		\$ 63,725.40

If the two last items be excluded as not available as cash, the balance of current liabilities on Dec. 31, 1895, (receivers' only) was \$1,068,683.65

The above statement, however, does not cover the entire ground as to which information will be desired. The following statement shows the result of operations on the following system mileage controlled by the receivers:

A. T. & S. F. R. R., Dec. 23, 1893, to Dec. 31, 1895, 4,582.12 miles		
G. C. & S. F. Ry., " 1, " " " 1,058. " "		
So. Cal. Ry. " " " " 490.98 " "		
N. M. & A. R. R., " " " " 87.78 " "		
Senora Railway, " " " " 262.61 " "		
W. & W. Ry., one-half, Dec. 1, 1893, to Jan. 31, 1895, 124.65 " "		
M. A. & B. Ry., " " " " 56.62 " "		
L. T. & S. W. Ry., " " " Feb. 28, 1894, 46.57 " "		
Gross earnings.....	\$58,737,391.03	
Operating expenses.....	46,123,763.55	
Net earnings from operations.....	\$12,613,627.48	
Taxes.....	\$2,986,344.23	
Rentals, tracks and terminals and locomotive and cars.....	1,089,821.15	4,076,165.38
Income from investments.....	\$8,537,462.10	664,963.27
	\$9,202,455.37	

The construction, improvement and equipment expenditures on the system mileage during the receivership amounted to.....

The amount of fuel, material and supplies on hand on all the system lines at conclusion of the receivership was.....

The balance of current liabilities over current assets upon all the lines of the present system, which were assumed by the new company, deducting assets not actually available as cash (principally fuel, material and supplies, on January 1, 1896, was.....

This includes pay rolls and vouchers for December, 1895, as well as all antecedent ascertained items. Pay rolls are made up after the end of each month and are paid about the 15th of the month following. Vouchers are filed with the treasurer as rapidly as the bills receive proper approval and authority for payment; the vouchers for any given month being substantially completed before the 25th of the next month, when the monthly statements are taken off.

In addition to the foregoing the new company assumed certain prior liabilities which could not be ascertained when the December statements were compiled. These are items which necessarily do not appear upon the books of a railroad company until liquidated, such as loss and damage claims, claims in pending suits and unsettled traffic adjustments, expenses not vouchered during January, 1896, repairs to equipment not turned over in running order, etc., the amount of which of course cannot be stated with precision. Under the reorganization plan the new company is furnished with funds sufficient to more than meet every form of antecedent liability, and begins its operations with no floating debt and with no contingencies not fully anticipated and provided for.

For the purpose of convenient comparison the following table is also submitted, showing the earnings of the present system mileage from July 1, 1893, to the end of the receivership, and the amount available for interest upon a statement of accounts corresponding to that which your reorganized company is entitled to make from and after January 1, 1896. The taxes and rentals deducted are the charges upon the entire present system for taxes, rentals of tracks and terminals and rental of locomotives and cars. The accounts of the subsidiary companies, from the operations of which income from investments is derived, are closed at various different dates. The price charged the railroad for coal bought of auxiliary coal companies was materially reduced during the receivership.

	—Fiscal Year Ending— 6 Mo. End—		
	June 30, 1894.	June 30, 1895.	Dec. 31, 1895
Gross earnings.....	\$30,385,654.29	\$28,532,982.98	\$15,409,362.65
Operating expenses.....	22,557,399.03	22,317,355.08	11,863,846.96
Net earnings.....	\$ 7,828,255.26	\$ 6,215,627.90	\$ 3,545,515.69
Taxes and rentals.....	1,698,181.92	1,753,647.08	876,276.84
Net income from operations.....	\$ 6,130,073.34	\$ 4,461,980.82	\$ 2,669,238.85
Income from investments.....	560,964.95	414,312.25	55,530.95
Balance applicable to interest.....	\$ 6,691,038.29	\$ 4,876,293.07	\$ 2,724,769.80

The period covered by the receivership has been one of exceptional depression and difficulty. The general financial distress which arose in the summer of 1893 was the direct cause of largely diminished earnings, and the occasion, in connection with other embarrassments, of the suspension of payment and consequent receivership which ensued in December of that year. Since that time the earnings of the line have never returned to what may be termed their normal volume. The first year of the receivership witnessed an almost total failure of the Kansas corn crop. The second year produced more corn, but the wheat and cotton crops were very light, while the corn was held back for a more favorable market. In 1894 the Debs strike occurred, as well as a protracted strike in the

coal fields. In 1895 there were serious storms and floods in the mountain region, embarrassing the flow of traffic and requiring unusual renewal expenses. A receivership administration is necessarily less productive than a corporate management.

The rate of taxation evidenced by the payment of \$2,986,344.23 on account of taxes by the system lines, represents 5.08 per cent of the total earnings and 23.67 per cent of the net earnings.

The operating expenses on the road of the receivership proper were 78 per cent of the gross earnings and on the system lines as a whole the percentage was the same. This is a high figure. An analysis of the detailed statement shows that the cost of movement (transportation and traffic expenses) was not unreasonable in comparison with former years. In fact, many economies were accomplished in this branch of the service, as well as in general expenses, in the course of the receivership administration. It is believed that more can be done in the same direction in future, especially in the way of increasing the tonnage hauled per train and per train mile.

The reason for the high operating expenses during the receivership years is found in the amounts expended under the heads of maintenance of equipment and maintenance of way and structures. These expenditures were heavy on all the system lines, particularly in 1895. They were regarded as necessary in order to bring the property up to the standard required for satisfactory use by the new company then in process of formation. No unusual renewal expenses should be required hereafter. The customary distribution of property expenditures between maintenance and improvements was continued during the receivership. As above shown, the improvement expenditures amounted to \$1,429,832.44. In addition to this, large sums were laid out for the betterment of the property, which were charged to operating expenses, or maintenance, so called. In making this distribution the usual rules were applied, e. g., in replacing a wooden bridge by a steel structure, the cost of a new wooden bridge was estimated and charged to maintenance, and the excess of cost of the steel structure over that of a new wooden structure was charged to improvements. The same rule was applied in respect to station houses and other buildings. Ballast on roadbed not previously ballasted was called improvement, while all repairs and additions to old ballast was maintenance. New steel rails were charged to maintenance. In these and other respects the rules employed on conservatively managed roads were applied.

An effort was made to bring all the engines and cars into serviceable condition and this work was nearly completed by the receivers. The engines were put through the shops. The passenger equipment was overhauled, painted and varnished. The freight equipment was thoroughly renewed with the exception of about 600 cars not reached. Air brakes have been used on freight trains for several years. The work of introducing automatic couplers was commenced. The equipment of the line is regarded as fully adequate for all probable demands, if kept in its present condition. Possibly the acquisition of coal and stock cars of improved construction may be found economical.

The principal extraordinary expenditure of the receivers not charged to improvement account will be found in the operating account entitled maintenance of way and structures. Renewals of ties increased from \$775,239.05 in 1892-3 to \$1,443,744.17 in 1894-5. Renewals of bridges and culverts from \$798,999.10 to \$1,144,626.79. Renewals of rails and fastenings from \$408,152.99 to \$547,350.09. These figures are given as illustrations. The mileage of wooden bridges was materially reduced. A great number of trestles were filled and arch and pipe culverts were introduced. A new bridge two miles long was built across Galveston Bay. The amount of work of this general description accomplished during the receivership was sufficient to fully account for the high percentage of operating expenses.

ALDACE F. WALKER,
JOHN J. MCCOOK,

New York, July 1, 1896.

Receivers.

AXLE, JOURNAL BOX BEARING AND WEDGE FOR CARS OF 80,000 LBS. CAPACITY.*

To make clear what follows it would appear best at the beginning of this report to indicate the plan which has been pursued. Considerable research and study was necessary before the work could be intelligently taken in hand, and your committee soon became aware that it could follow a certain line of investigation which would finally lead to reasonably safe conclusions, provided definite information could be obtained. To have merely stated conclusions and submitted detail drawings would have left your association undecided as to the value of the conclusions. If the conclusions were approved it would have

*Report of committee to the Master Car Builders' Association, June 17, 1896.

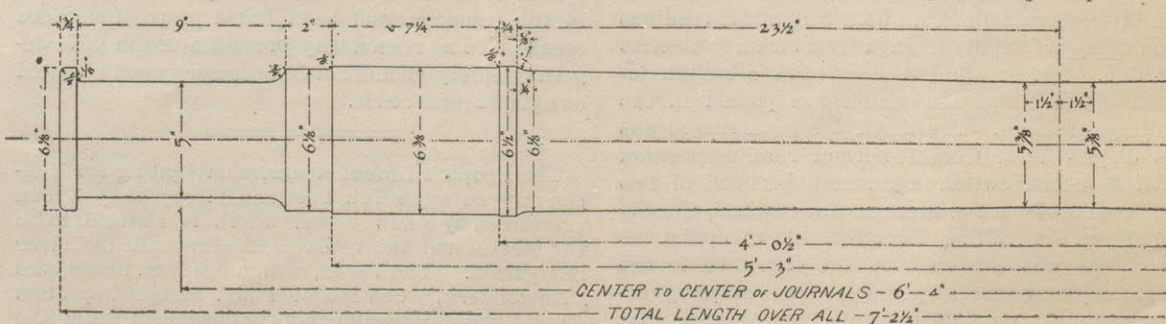


FIG. 2.—AXLE DESIGNED TO CARRY 31,000 LBS.

shown confidence in your committee but would not have been the intelligent indorsement of its work, which is far more to be desired.

It was decided, therefore, to give as briefly as was consistent with clearness the method and facts; and if the conclusions are open to criticism the defects in the reasoning which lead to them may be pointed out.

The larger part of the report has been devoted necessarily to the axle, not only because it was essential first to decide upon its design before the journal box, wedge and brass could be considered, but because it was realized that there were two limits between which it was necessary that the design should fall. The first of these was that the limit for strength should unquestionably leave no doubt as to the safety of the design. The breaking of a car axle is becoming daily a more serious matter. On double track roads it involves not only the safety of the train in which it may fail, but of both passenger and freight trains on the opposite track. Evidence of the

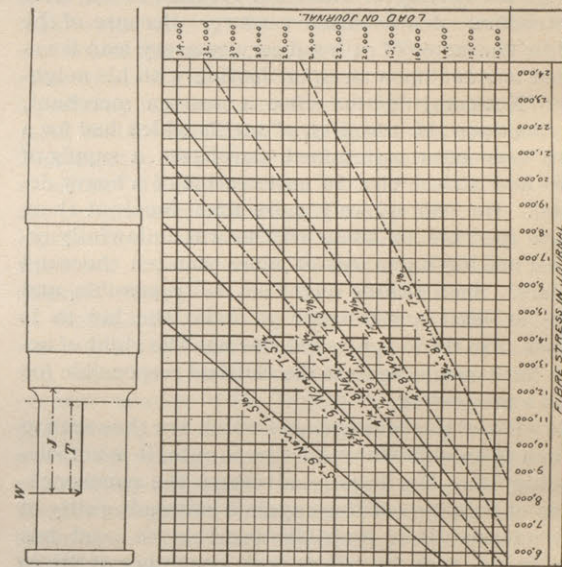


FIG. 1.—COMPARATIVE STRESSES FOR DIFFERENT SIZED JOURNALS.

seriousness of this matter is only too easily obtained. The other limit was that of cost. To meet these ends has been the aim of your committee. There appears to be no question concerning the proper policy for any railroad to pursue in the selection of axles. The increased cost of axles of proper design and good material over those of poor design and inferior material will be insignificant compared with the losses, both in money and human life, which must result from using axles too weak to stand the strains to which they are subjected.

The plan of the report is to discuss first theoretically the matter of strains in the axle, in which is included from practical information the important element of vertical oscillation on the springs. The question of fiber stress is then considered, and following this is a discussion of the journal proportions from the standpoint of friction and lubrication. Conclusions having been reached under these heads the design of the axle naturally follows, with specifications for the material to be used.

(An analysis of the forces acting on a car axle were worked out by Prof. A. J. DuBois of the Sheffield Scientific School, which was presented in full by the committee, but which as well as the calculation of the stresses by Wohler's method are omitted for lack of space.—Ed.)

Axles of good material never break in service at a single blow; even in a wreck such axles will be found bent. Breakage may occur, however, as the result of poor material, bad design in respect to shape, the spreading of an initial crack, or from repeated applied stresses above a safe limit in magnitude.

The various stresses to which a revolving axle is subjected, except those due to accidental shock, result in repeated reversals of load upon the fibers of the material, alternately compressing and extending the same. It is, therefore, necessary to study the effect of repeated strains set up in the axle in this way. When testing was first employed to determine the nature of a material, it was quickly noticed that when the specimen was loaded or bent beyond a certain point it would not recover its original dimensions or shape upon the removal of the load. The limiting stress or straining, below which no permanent effect upon the specimen could be noticed, was called the "elastic limit." It appeared obvious to experimenters that since the specimen recovered completely its original form and dimensions, it had not been injured, and it would be safe to apply any loads within the elastic limit indefinitely without any injury resulting. Subsequent practical

experience, however, proved that under the conditions of repeated reversals of stress it is not safe to subject a bar to a strain anywhere near the elastic limit as determined in the testing machine. This led to the exposition of the theory of what may be called "the fatigue of metals." This theory, while disbelieved by some authorities, has been so broadly accepted by others that axles and other vital elements of railway rolling equipment have been condemned for use after being subjected to a certain number of strain reversals.

The evidence to be obtained from the study of authorities upon this subject and from experience would appear to establish the fact that a bar of iron or steel when subjected to repeated reversals of stress somewhat below the elastic limit of the material, as determined in the testing machine, will ultimately fracture in such service.

According to Wohler, who spent some twelve years at the instance of the Prussian government in experimenting upon the effect of repeated stresses in small bars, the outer fiber stresses, where the strains alternated between tension and compression, he found might be safely taken

out danger of serious error to the structure of a railway axle and within the limit of life of such axle.

The influence of repeated stress upon the molecular structure of iron or steel is likewise involved in contradiction. There seems to be little doubt that a change in structure may occur after alternations of severe stress, sudden strains and recoils. The degree of the stresses, etc., seems, however, to be all important in determining any such change, and there seems to be no evidence to show that when the fibre stresses are kept below the natural elastic limit, any apparent change in the structure will occur before the axle is condemned by reason of being worn out at the journal.

As to the effect of temperature, it seems to be pretty well established that the effect of ordinary atmospheric changes of temperature, say, from 20 deg. below to 120 above zero Fahr., upon the physical properties of iron and steel, are slight and unimportant when stresses are applied without shock. But the effect of a change of temperature upon the ability of these metals to resist shocks, is not so definitely known.

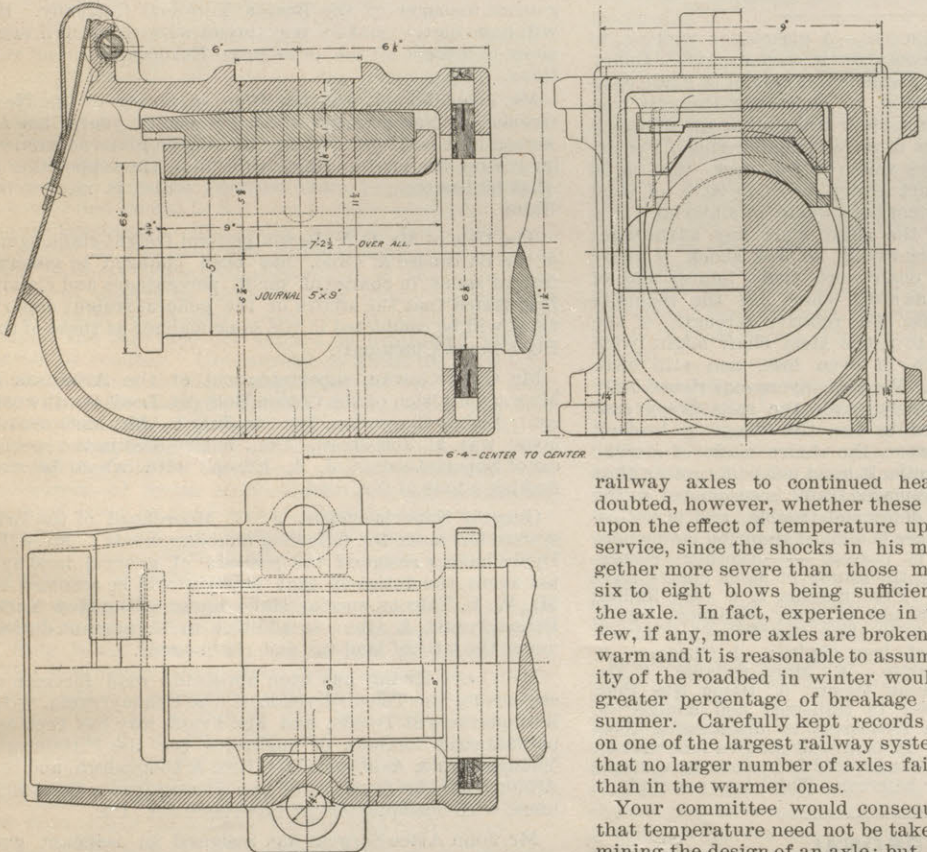


FIG. 3—JOURNAL BOX FOR 5 x 9 IN. JOURNAL.

as 17,000 lbs. per square inch for iron and 23,000 lbs. per square inch for steel, without limiting the life of the bar, but if the stresses exceed these limits, fracture would always occur if the number of repetitions of stress were sufficient. This is a stress of approximately $\frac{1}{8}$ the tensile strength of the material, and is considerably within the elastic limit as ordinarily determined.

In an article upon "The Elastic Limit," in London Engineering, August 7, 1891, extended comment is made upon the important researches of Prof. Bauschinger of Munich. Bauschinger determined what he termed the "natural elastic limits" of a bar in tension and compression. These limits he defined to be the limiting load to which a bar of the same material can be strained repeatedly in tension and compression without breaking, when the loading is repeated sufficiently often, as determined by Wohler. The "natural elastic limit" for both tension and compression in best wrought iron was found to be about 19,000 lbs. per square inch, and is considerably below the elastic limit as ordinarily determined. The explanation of this fact is given that the welding, forging, or other manufacturing process to which a bar has been subjected, temporarily raises its elastic limit, which is again lowered to its true value under the influence of alternating stresses.

Hence, in Wohler's experiments, in which bars broke at loads nominally below their elastic limits, there is a good reason for concluding that they were really strained above their natural elastic limits. Again, in large bars, such as car axles, where the extreme or outer fibers are a considerable distance from the neutral axis, and where the material is often far from homogeneous throughout, it is reasonable to suppose that strains are not transmitted symmetrically in all its parts and some of the fibers may bear a larger proportion of the total stress than would occur in even distribution. In this way the elastic limit may be locally exceeded with a very moderate total stress only.

From all evidence it seems reasonable to conclude, that a material will not be injured if strained repeatedly any amount within its natural elastic limit; that the so-called "fatigue of metals" may be noticed if strains are in excess of this natural elastic limit, and still within the elastic limit as ordinarily determined; that there is a possibility of the natural elastic limit being exceeded at points locally within the structure of a large mass by a moderate total strain, thus starting local cracks which will extend to the ultimate destruction of the piece.

Your committee offers the above conclusions with considerable hesitation as is fitting in a subject involved in so much confusion, but believes that they will apply with-

Mr. Thos. Andrews in a paper read before the Institution of Civil Engineers, 1887, gave results of test by impact under a drop hammer of 42 full size iron axles, the axles having been heated and cooled to various degrees, for the purpose of determining the effect of temperature upon strength. He found that at 100 deg. Fahr. the axles were 43 per cent stronger than at 7 deg., and concludes that low temperature materially reduces the power of resistance of rail-

railway axles to continued heavy impact. It is to be doubted, however, whether these tests throw much light upon the effect of temperature upon axles as stressed in service, since the shocks in his method of tests were altogether more severe than those met with in service, from six to eight blows being sufficient in each case to break the axle. In fact, experience in this country shows that few, if any, more axles are broken in cold weather than in warm and it is reasonable to assume that the greater rigidity of the roadbed in winter would fully account for any greater percentage of breakage in that season than in summer. Carefully kept records of axles broken or bent on one of the largest railway systems in this country show that no larger number of axles failed in the colder months than in the warmer ones.

Your committee would consequently offer the opinion that temperature need not be taken into account in determining the design of an axle; but that with more definite information it may be advisable that certain limits for variation of temperature should be established as standards for use in testing axles under the drop.

Coming now to the allowable fiber stress, your commit-

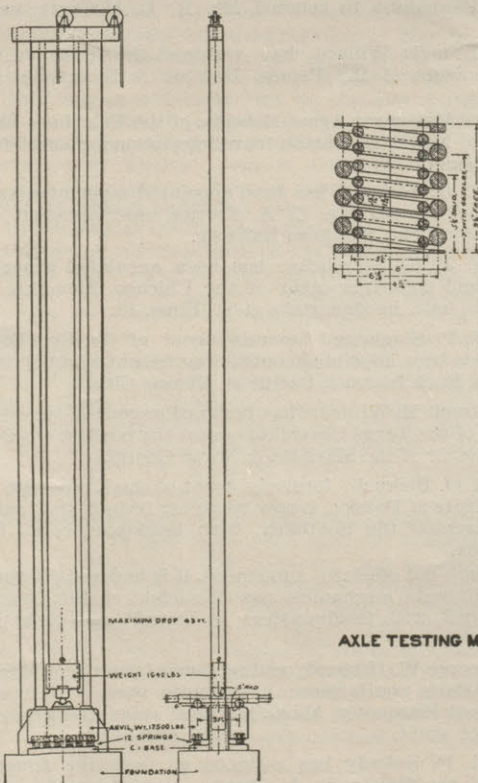


FIG. 4—AXLE TESTING MACHINE AND SPRINGS.

tee may say that if its foregoing conclusions are accepted, it follows that a design of axle which, under all conditions of repeated straining, keeps the fiber stress within the natural elastic limit of the material, will be a safe one, so far as danger of breaking is concerned.

It has been stated that Wohler found that for an unlimited number of reversals of strain, the fiber stress may safely be taken at 17,000 lbs. per square inch for iron and 23,000 lbs per square inch for steel. But as his experiments

were made with small specimens, and as axles are subjected to various stresses, apparently not included in his investigations, it would seem best to look into the fiber stress of axles in service and see what can be learned. The method of Reuleaux can readily be utilized to determine the fiber stress of any given axle. It is only necessary to find the moments and from the actual diameters find the fiber stress by a change in the formula already given for finding the diameters when the fiber stress is known. The formula would then be

$$f = \frac{M}{.0982 d^3}$$

where

M = the moment,
 d the diameter at any point,
 f the fiber stress.

Your committee has followed this method for axles already in use, where they have been in service a number of years, and where the number of axles has been sufficient to justify safe conclusions by such an analysis.

Taking the fiber stress calculated in this way it was found that a large number of axles had broken of one design where the fiber stress was 28,000 lbs., these axles having been in service from four to nine years. Where the fiber stress was 23,000 lbs. and less, the record shows that axles have been practically free from failure by breaking. The fiber stress of 28,000 lbs. was found approximately the same at the wheel seat and center, and the records showed that breakage took place at both of these points. Furthermore, the axles with the lower fiber stresses, and which have not broken, show that for the strains found by Reuleaux's method the fiber stress is approximately uniform between the wheels. It is important to note this fact because some writers have based their designs upon considerations of static loads only, and naturally, for the same design, their allowed fiber stress would be a great deal less than the figures given above. Your committee has concluded, therefore, that if the new axle is designed, using the strains as found by Reuleaux's method, and if a fiber stress of 22,000 lbs. per square inch is taken for the portion of the axle between the wheels, and the material provided in the specifications, is used, a safe design will be the result without much surplus material.

Concerning the fiber stress in journals, this portion of the axle is subjected to strains of a more complicated nature, and the results of experience will be the safest guide. From an examination of the fiber stress in journals which have broken and which have not broken, it is concluded that, for the diameter attained when the journal is worn to its limit, the fiber stress for static load should not exceed 11,500 lbs. per square inch. It would be safer to keep it close to 10,000 lbs. per square inch, which figure has been adopted for the diameter when it has reached the limit of wear.

From the diagram, Fig. 1, the fiber stress in a 5x9 in. and 4 1/4 x 8 in. journal when new, worn, and worn to limit, can be found for any load from 9,000 lbs. to 35,000 lbs. The load W is applied at a distance J from the shoulder of dust guard seat. The value of J is 5 1/2 in. for a 5x9 in. journal, and 5 1/4 in. for a 4 1/4 x 8 in. journal. The lever arm T for moments is shown in each of the diagram, and is taken from tangent of circle at fillet to point of concentration of load W .

It will be seen that the stress under a static load of 15,500 lbs., is for a new axle with 5x9 in. journal, 6,300 lbs., and when worn to limit, 4 1/2 in. in diameter, it is 10,200 lbs. A new axle with 4 1/4 x 8 in. journal with a static load of 11,000 lbs. would have a fiber stress of 6,500 lbs. when new, and 10,800 lbs. when worn to the limit of 3 1/4 in. in diameter. The stress in the journal due to any assumed maximum load may thus be found direct from the diagram.

The following gives the loads per square inch on various journals.

1. 4 1/4 x 8 in. journal, new . . . pressure per sq. in.,	449 lbs.
2. 5x9 in. journal, new . . . " " "	469 "
3. 4 1/4 x 8 in. (worn to 3 1/4 in.) . . . " " "	533 "
4. 5x9 in. (worn to 4 1/2 in.) . . . " " "	525 "
5. Bearing (I) on journal (3) . . . " " "	1280 "
Dentons limit	1000 "

In our final calculations we have assumed the probable maximum conditions for concentration of the load on journal, which would be when the collar of the journal is worn to 1/4 in. in thickness from contact with the brass and the brass worn off 3/4 in. on the end next to the collar of the journal. This occurs when the horizontal force previously explained is at its maximum.

In connection with the specifications for testing axles the following is submitted with regard to the drop tests:

All axles will be tested physically by drop test. The testing machine must conform in its essential parts to drawings which will be furnished by the railroad company. These essential parts are: The points of supports on which the axle rests during test must be 3 ft. apart from center to center; the tup must weigh 1,640 lbs.; the anvil, which is supported on springs, must weigh 17,500 lbs.; it must be free to move in a vertical direction; the springs upon which it rests must be 12 in number of the kind described on drawing, and the radius of the supports and of the striking face on the tup in the direction of the axis of the axle must be 5 in. When an axle is tested it must be so placed in the machine that the tup will strike it midway between the ends, and it must be turned over after the first and third blows. After the first blow deflection of the axle under test will be measured in the manner specified below.

It is desired that axles when tested under the drop, as specified above, should not deflect more than 5 1/2 in. after the first blow, and should stand five blows without rupture or fracture in any way.

Axles will be considered to have failed on physical test and will be rejected if when tested under the drop, as

specified above, they rupture or fracture in any way as a result of five blows from a height of 23½ ft., or if the deflections after the first blow exceeds 6½ in.

In order to measure the deflection prepare a straight-edge as long as the axle by re-enforcing it on one side, equally at each end, so that when it is laid on the axle the reinforced parts will rest on the collars of the axle, and the balance of the straight-edge not touch the axle in any place. Next place the axle in position for test, lay the straight edge on it, and measure the distance from the straight-edge to the axle at the middle point of the latter. Then after the first blow place the straight-edge on the now bent axle in the same manner as before, and measure the distance from it to that side of the axle next to the straight-edge at the point farthest away from the latter. The difference of the two measurements is the deflection.

In both of these specifications it will be noticed that provision is made for a definite form of apparatus for the drop test. The difficulties with the form of apparatus for the drop test heretofore used have been: First, the same drop produces less deflection in summer than in winter, due to the ground being softer at the former season, and hence there is more yielding or elasticity in the foundation of the anvil block; second, the possibility of manufacturers using a more elastic or yielding foundation in order to produce less shock upon the axle from the drop test; third, tests made with one machine are not comparable with those made on another, on account of the variation in the character of the foundations.

The apparatus proposed overcomes all these objections, as the anvil block rests upon springs, and has at all times practically the same inertia, and the blow upon the axle produces the same force of impact, regardless of the character of the ground upon which it may be located.

The drop testing machine referred to is shown in the accompanying illustration, Fig. 4. The specifications of the springs are as follows:

SPECIFICATION FOR SPRING.

1st bar, 13-16 in. diam., 99½ in. long, tapered to 109¾.	
2nd " 13-16 in. " 99½ in. " " 106½.	
Normal weight, 1st bar, 31 lbs. 1 oz.	2nd bar, 14 lbs. 10 oz.
Minimum " " 30 lbs. 2 oz.	" 14 lbs. 2 oz.
Large single coil, height free	9½ in.
" " " solid	5½ in.
" " " with 4550 lbs. 7 in.	
" " " capacity solid	7750 lbs.
Small single coil, height free	9½ in.
" " " solid	5½ in.
" " " with 2100 lbs. 7 in.	
" " " capacity solid	3600 lbs.
Height of both springs, free	9½ in.
" " " solid	5½ in.
" " " with 6650 lbs. 7 in.	
Capacity of both springs, solid,	11350 lbs.

The design of the axle by the method of Reuleaux resulted in the diameter at the hub being taken as 6¼ in., and for the center of the axle 5½ in.

In order to make clear the difference between an iron axle and one of steel, the following table will show the fiber stresses at the hub and center for the M. C. B. 4¼x8 axle and the proposed axle with 5x9 journals, which are calculated for the static load only, and which give also the factor of safety based on ultimate strength:

	Hub.		Center.	
	Fiber Stress.	Factor of Safety.	Fiber Stress.	Factor of Safety.
		Steel.	Iron.	
M.C.B. 4¼x8	6582	11.39	8.35	10331
Proposed 5x9	6342	11.82	8.67	10011
				7.26
				5.32
				7.49
				5.49

In this table the factor of safety is based on steel of an ultimate strength of 75,000 lbs. per square inch, and iron of an ultimate strength of 53,000 lbs. per square inch.

The table shows for the factors of safety at the centers, that if the strength of steel is 100 then the strength of iron is 73.3.

It must not be supposed that the factors of safety here given represent the actual margin of strength in the axles referred to. They are purely hypothetical factors of safety based upon only the strains due to static loads, and the actual factors of safety where all strains are considered will be much smaller. The table merely indicates the relative values of iron and steel.

It will be noticed that the axle (see Fig. 2) is cylindrical for a distance of 3 inches at the center, in order to get rid of the angle at the center. The wheel seat is made 6½ inches to provide for ¼ inch reduction in fitting axels to wheels, and still be above the theoretical diameter. The fillet at outer end of journal is made as small as possible without getting a sharp corner, and still making it easy to obtain in ordinary shop practice. The fillet at back end of journal is made large to prevent the rapid wearing to a small fillet at this part of the journal.

Fig. 3 shows the journal box and the contained parts in position.

The general design of the M. C. B. journal boxes, already adopted by your association, has been followed, except that the bottom of the box has been rounded in order to eliminate the corners and to concentrate the oil below the center line of journal, where it has the greatest opportunity to be drawn into the packing.

AN EXHIBITION RAILROAD COLLISION.

An enterprising management arranged for a mock head end collision as a Fourth of July tableau, to amuse and instruct the people in the vicinity of Chicago who were willing to pay for the privilege of seeing two trains come together upon a single track. Two engines, built at the Rogers Locomotive Works, and weighing about 35 tons each, which had seen in

the neighborhood of sixteen years of service were selected, and each engine was coupled to three box cars which also were not new, though both outfits were bright with paint. A track was arranged for the purpose in the town of Cicero, eight miles west of Chicago, on the Chicago & Northern Pacific Railroad. The trains were run together at a speed of about 25 miles per hour instead of the advertised speed of 40 miles. The engine crews saved themselves by jumping, and the collision is reported to have been entirely satisfactory, and it is also stated that the larger part of both trains, including the locomotives, was carried away by relic hunters. This is the second show of this kind which has been given in this country and it seems to be the best of evidence that actual railroad collisions are getting to be so infrequent as to necessitate trumping up exhibitions of this sort in order to satisfy the morbid desire of the public to witness such destruction.

STEEL VS. CAST IRON CHAIRS.—A platelayer writing to an English journal observes that it seems extraordinary that, in an age of steel, a steel chair cannot be made commercially and mechanically to supersede the cast iron chair, the present cast iron chair being quite out of touch with other improvements in railway engineering. For example, many of the chairs weigh 56 lbs. each—that is, 56 lb. of cast iron to support every 80 lb. or 90 lb. of steel rail. This is surely an enormous waste of material. It is not as if the weight of the chair were any advantage; quite the reverse. There would be less shock if there were no chair, or if the chair were made lighter and of stronger material, such as steel, which has the requisite properties for this purpose. The relative strength of the two metals being, say, 5 to 1, the steel chair might with safety be reduced to 20 lb., or even less, and still have ample margin for safety. We platelayers experience daily the fact that when a vehicle leaves the rails every cast iron chair that is touched by the tire flange is broken. This could not happen were the chairs made of similar material to that of the rails. It must not be forgotten that until broken chairs are replaced traffic is suspended on the line. This causes much delay and trouble, and is noticeable every day where there is a lot of shunting, and where heavy mineral traffic is passed. Another correspondent writes: "Some thousands of steel chairs have recently been put down. Five months is a very limited period to make a practical test of their efficiency, but it has been quite sufficient to show the following advantages of steel over cast iron chairs: 1. Cheaper. 2. Stronger. 3. More elastic. 4. More reliable. 5. Derailed wagons will not break them. 6. Being less than half the weight, are easier to transport and handle. 7. Do not break by rough treatment in discharging from wagons and in keying. It is a well known fact that an ordinary cast iron chair can be readily broken by a single blow from a 12 lb. sledge hammer. This does not apply to steel chairs."

PERSONAL.

Mr. Henry Cooper has resigned as assistant general freight agent of the Baltimore & Ohio Southwestern

Mr. E. T. Whiter has been made assistant trainmaster of the Panhandle to succeed Mr. R. E. McCarty, promoted.

Mr. Francis Willard has resigned the position of general agent of the Peoria, Decatur & Evansville at Peoria.

General Passenger Agent Roberts, of the Erie lines, has appointed Mr. E. H. Barton traveling passenger agent for the company.

Mr. T. H. Simpson has been appointed superintendent of car service and Mr. C. A. Tarlton superintendent of telegraph of the Southern Railway.

Mr. E. J. Knickerbocker has been appointed general freight and passenger agent of the Chicago, Memphis & Paducah, with headquarters at St. Elmo, Ill.

Mr. W. T. Singleton, formerly agent of the Erie Dispatch, has been appointed contracting freight agent of the Chicago, Rock Island & Pacific at Kansas City.

Mr. Joseph McWilliams has resigned as general superintendent of the Texas Central to accept the position of general manager of the Marietta & North Georgia.

Mr. M. O. Bicknell, formerly agent of the Evansville & Terre Haute at Potoka, is now traveling freight and passenger agent of the Southern, with headquarters at El Paso, Tex.

Although not officially announced, it is understood that Mr. H. Roberts, mechanical superintendent of the Grand Trunk road, with headquarters at Detroit, has resigned that position.

Mr. George W. Hibbard, acting general passenger agent of the Duluth, South Shore & Atlantic road, with headquarters at Marquette, Mich., has been appointed general passenger agent.

Mr. E. P. Snively has resigned as traveling freight agent of the Baltimore & Ohio to accept the position of chief engineer to Mr. E. T. Affleck, western coal and coke agent of the same road.

The Chicago & Northwestern line has established a new position in the freight department to take charge of lake traffic. Mr. P. E. Rockwell has been appointed "lake man," and will take hold at once.

Mr. John Teufer, who has been with the Toledo, St. Louis & Kansas City three years, has been appointed master car builder of the Lehigh Valley, and has already entered upon his new position.

Mrs. Wm. H. McDoel, wife of the general manager of the Louisville, New Albany & Chicago road, died in Chicago, Monday morning last, after a brief illness. Mrs. McDoel was beloved by all who knew her.

The position of assistant general freight agent of the Louisville, Evansville & St. Louis, heretofore filled by Mr. C. D. Morris, has been abolished. Mr. Morris has been made chief clerk in the general freight department.

Mr. J. P. Beckwith, general freight and passenger agent of the Savannah Line, will be appointed successor of General Passenger Agent Richardson, of the Florida East Line, recently elected commissioner of the Southern States Passenger Association.

Mr. Henry Coope, assistant general freight agent of the Baltimore & Ohio Southwestern, has severed his connection with that company, after thirty-one years' continuous service with that company and the Ohio & Mississippi. Mr. Coope's resignation was voluntary.

Mr. John C. Sanborn, superintendent of the Plymouth division of the old Cape Colony Railroad, has been elected general manager of the Boston Terminal Company. He will immediately make a trip abroad with three civil engineers to inspect all the prominent European railroad stations.

Mr. John Glynn, who has been secretary of the New Orleans & Northeastern for a number of years, has resigned that position. While Mr. Glynn gives no particular reason for having taken this step, the supposition is that he has secured other business which is more to his liking.

The title of Mr. C. V. Lewis, general freight claim agent of the Baltimore & Ohio, has been changed to general freight agent, in charge of tariff, percentages and claims. It is stated that the affairs of the general freight department will be conducted in the same manner as those of the Big Four at Cincinnati.

Mr. O. McGowan, superintendent of the Arkansas & Missouri division of the Cotton Belt (St. Louis Southwestern), died at Clarendon, Tex., on July 1. Mr. McGowan's home was at Jonesboro, Ark., but he died in the special car of Superintendent J. A. Edson, with whom he was making a tour of the road.

General Superintendent J. C. Moorehead of the Erie system has made the following announcements: Mr. J. H. Dynes having resigned the position of general land and tax agent, the duties of that position will be assumed by Mr. W. E. Talcott, special claim agent of the New York, Pennsylvania & Ohio, in addition to his present duties, under the title of land tax and claim agent.

Mr. Court Ewing has been appointed road foreman of engines for the Toledo division of the Pennsylvania, with headquarters at Toledo, and Mr. Frank Ray has been appointed road foreman of engineers for the Pittsburgh, Youngstown & Ashtabula, the Erie & Pittsburgh, and the Alliance & Niles divisions of the Pennsylvania Company lines, with headquarters at Lawrence Jct., Pa.

Mr. John Attee Sargent has resigned as assistant general freight agent of the Kansas City, Fort Scott & Memphis Railway to accept the position of general freight agent of the Kansas City, Pittsburgh & Gulf Railway. The position is a new one created last week, when the combined offices of general freight and passenger agent were divided and Mr. H. C. Orr of the Burlington was given the passenger department.

Mr. Charles A. Shinn, who for over four years has been chief clerk and general bookkeeper in the auditing department of the Wheeling & Lake Erie road, has now been made assistant auditor. Mr. Shinn is recognized as one of the ablest expert accountants in the business, having also been connected with the Clover Leaf and the Cincinnati, Jackson & Mackinaw previous to his service with the Wheeling.

Mr. Joseph A. Jordan, general manager of the Hannibal & St. Louis Railway, has been made vice president of the Green Bay & Western the reorganized Green Bay, Winona & St. Paul. He will have charge of the operation of the Green Bay line and will also retain the general management of the Hannibal & St. Louis. Mr. Jordan was for many years connected with the management of the Chicago & Alton.

Mr. Edward H. Waldron, formerly general manager of the Ohio & Mississippi, and who in his railroad career had been connected with the roads in Illinois and Indiana which comprise the Lake Erie & Western system, was buried at Lafayette on Sunday, July 5. The deceased retired from railroading about ten years ago and went into the manufacture of railway lanterns; later he became partner in two large livery stables at Chicago. He was born at Auburn, N. Y., in 1853, and came west when quite a young man and located at Lafayette.

RAILWAY NEWS.

Bangor & Aroostook.—Great improvements are going to be made on the B. & A. the coming season, and this is especially so of the Moosehead Lake division. About \$70,000 will be expended on rebalasting the track. Instead of the single telegraph wire from Milo Junction to Greenville, a double line is being put up. A woven wire fence is being strung to take the place of barb wire, board and rail fences. A survey has been made for a 2½ mile extension from Island Falls to the head of Mattawamkeag Lake in Aroostook county.

Chicago & Indianapolis Terminal.—The Chicago & Indianapolis Terminal Co., which is a part of the Louisville, New Albany & Chicago R. Co., has filed a mortgage with the

County recorder for \$300,000. The mortgage is to secure 6 per cent gold bonds, issued to pay for the terminal recently acquired in Indianapolis. The American Trust & Savings Bank of Chicago is the trustee.

Galveston, LaPorte & Houston.—An order of Judge Bryant was filed July 1 in the office of clerk of the federal court, issued at Paris, in which, on the application of the receiver of the Galveston, LaPorte & Houston road, the Galveston, Houston & Henderson, the International & Great Northern, and the Missouri Kansas & Texas, or their agents, or attorneys, are restrained from filing any acts to obstruct or hinder the LaPorte receivers from laying its track across the disputed block 517, and crossing respondents' tracks thereon to a connection with the wharf companies' tracks, pending a hearing at Paris, July 8. The injunction was served on defendants. This company has this year built an extension two miles in length from Brady Junction to a connection with the Southern Pacific in Galveston. This new line crosses Buffalo Bayou and gives the Galveston LaPorte & Houston an entrance into the Union depot at Galveston.

Georgia Midland.—Commencing on July 1, the Georgia Midland is to be operated by the Southern Railway system by which company the property has been leased for 99 years. Mr. G. S. Hobbs, auditor for the Midland, gives notice that all balances for car mileage, freight and ticket account and all bills and claims in favor of or against the Georgia Midland Railway company originating on and after July 1, 1896, will be settled by the Southern Railway company and should be included in their accounts. Business of the company originating prior to July 1, 1896, will be settled by the Southern Railway company separately from business originating subsequent to that date. Remittances should be made to, and drafts for balances drawn on H. C. Ansley, treasurer, Washington, D. C. Claims and bills are not subject to draft and will be settled by voucher. The railroad is about 100 miles long, from Columbus to McDonough, Ga. It was built some years ago as the Georgia Midland & Gulf, being intended to form a connection between Columbus and Atlanta. It was not completed, however, beyond McDonough. The old road was sold at foreclosure sale early this year and was purchased by the bondholders. It is said that under the lease taken by the Southern Railway that company is to pay the floating indebtedness of the road, its car trust and the reorganization expenses, and to pay a sum of \$49,000 annually as rental.

Gulf & Ship Island.—According to the New Orleans Picayune, Colonel Tom Hale, traffic manager of the Gulf & Ship Island R., with headquarters at Hattiesburg states that things are in good shape on that line. Since Colonel Hale's connection with the Ship Island road a great deal of new road has been opened up, and the prospects of the line are better than usual. This road is now being operated by a northern concern, who built it, and they will have it in hand until they recover the money spent in its construction. Col. Hale thinks the outlook for the road is excellent.

Kansas City & Omaha.—The Kansas City & Omaha was sold at auction on the 8th inst., and was bid in by parties representing the stockholders. Consideration, \$150,000. The property consists of the lines from Fairfield to Strottsburg, Fairbury to McCooi Junction and Alma Junction to Alma—192 miles.

Lima Northern.—The track of the Lima Northern R. was completed to a junction with the Wabash R. near Adrian Mich., on the evening of July 1. This is the original point to which the road was projected, but the plan was changed and the road will be built to Detroit Junction. It is thought that within two weeks, freight and passenger traffic will be opened on the line between Lima, O., and Detroit.

Manistee & Grand Rapids.—Track is being laid on the extension to this line from the crossing of the Chicago & West Michigan to a point near Luther, a distance of 13½ miles. The total length of the line will be 42.8 miles and will connect the towns of Manistee, Oak Hill, Filer City and Luther, Mich. About 26 miles of main line was constructed previous to 1892; about 3½ miles was added in 1895. There has been some talk of continuing the road to Cadillac, but this has not yet been decided. Heretofore it has been used as a lumber road but it is now proposed to put on passenger trains and do a regular freight and passenger business. The money for its construction has all been furnished by its directors and it has no debts. With the exception of two truss bridges and one fill of 80,000 cu. yards, all construction work has been done by day labor under the direction of the superintendent and chief engineer. Mr. John Canfield of Manistee is president and Mr. E. W. Muenschler of the same place is chief engineer.

Memphis & Charleston.—The first mortgage bondholders of the Memphis & Charleston road through their representative, Mr. John D. Caldwell, has filed a bill at Aberdeen, Miss., to foreclose the mortgage and asking for the sale of the road. Similar bills have been filed in the Tennessee courts at Memphis and the Alabama courts at Huntsville. It is generally understood that the road will be ordered sold within a few weeks and that the Southern R. by whom the bonds are chiefly held will undoubtedly become the purchaser. One of the courts will issue a decree of sale for the property, which will be concurred in by the judges of the different courts through which the road passes. The first mortgage amounts to \$1,000,000.

Olean, Bradford & Warren.—It is said that after Monday next the Olean, Bradford & Warren, which for 18 years has been the narrow gage connection of the Western New York & Pennsylvania, between Buffalo and Bradford via Olean, will be abandoned and direct connection between

these two points be made via the Carrolton crossing, and the Buffalo, Rochester & Pittsburgh road. The Western New York & Philadelphia has built a curve at Riverside or Carrolton crossing on its Oil City division, connecting with the Buffalo, Rochester & Pittsburgh track, and will run its trains through from Olean by way of its Allegheny river division to Bradford over that route into its present narrow gage station at Bradford. In order to do this a short piece of road has been built in Bradford from the Buffalo, Rochester & Pittsburgh track over to the Bradford depot of the Western, New York & Philadelphia. This will make a much better and quicker trip to Bradford from Buffalo, than the old route. The Olean, Bradford & Warren R. was completed on Feb. 7, 1878, and was opened for public traffic on Monday, Feb. 11. It was an event of much importance to Buffalo, as it opened up a direct road with the then fast developing Bradford oil field, in which many Buffalo people were extensively interested. The road is 23 miles long, but exceedingly serpentine in its course, which may be gathered from the fact that the two points connected, Olean and Bradford, are only 12 miles apart on an air-line.

St. Lawrence & Adirondack.—Articles of consolidation for the St. Lawrence & Adirondack and the Southwestern have been filed at Albany, N. Y., with the secretary of state. The Southwestern Railway is a division of the Grand Trunk system and connects Valleyfield with Beau Harnois in the Province of Quebec, a distance of 13 miles. The united Company will assume the name of the St. Lawrence & Adirondack Railway. The directors of the new company are Wm. Seward Webb, Chauncey M. Depew, Edgar Van Etten, John Jacob Astor, Charles H. Burnett and Henry L. Sprague of New York, Martin E. McClary of Malone, Edward C. Smith of St. Albans and Reuben W. Leonard of Beau Harnois, Quebec. The principal offices are to be at Montreal, Can., and the capital stock is \$1,090,000.

St. Joseph Valley.—It is now thought to be an assured fact that the St. Joseph Valley road will be extended from Berrien Springs to Benton Harbor. Berrien Springs residents are enthusiastic over the prospect of a through line to the lake, and will extend material aid in the financial part of the venture. The ten miles of track from Buchanan to Berrien Spring has been put in first class condition and the ties for the remainder of the distance will be on the ground the first of the week. As large a force of men as can be used in the work of construction will be at once put on along the projected route, and an effort made to have the line ready for the rolling stock by October 1.

San Antonio & Gulf Shore.—The San Antonio & Gulf Shore R., 28 miles long, running from San Antonio to Sutherland Springs, was sold by the receiver, Henry Terrell, under order of court on July 7. The only bidder was Oscar Bergstrom, who bid \$150,000, the minimum fixed by the court, and the road was knocked down to him. Captain William Davis who built the road, warned purchasers that they would buy a lawsuit with the road. Mr. Bergstrom has two days in which to pay for the road, and in the meantime he declines to say for whose interest he purchased the property. It is believed, however, that the purchase was for the original stockholders, Dullnig, John Ireland and others.

Seattle, Lake Shore & Eastern.—The road heretofore known as Seattle, Lake Shore & Eastern has, under date of July 1, issued the following circulars: The Spokane & Seattle Ry. Co. having succeeded to the property and franchises of the Seattle, Lake Shore & Eastern Ry. Co., east of the Cascade mountains, this day assumes charge of and will operate said property under the title of Spokane & Seattle R. Co., with general offices at Seattle. The officers are as follows: John B. Allen, vice president; H. G. Struve, secretary; Geo. W. Harris, auditor; Struve, Allen, Hughes & McMicken, attorneys.

The Seattle & International Ry. Co. having succeeded to the property and franchises of the Seattle, Lake Shore & Eastern R. Co., west of the Cascade mountains, this day assumes charge of and will operate said property under the title of Seattle & International Ry. Co., with general offices at Seattle. The officers of the company are as follows: John B. Allen, vice president; H. G. Struve, secretary; Newman Kline, superintendent and purchasing agent; Harry R. Talcott, chief engineer; F. A. Allen, general freight and passenger agent; George W. Harris, auditor; Struve, Allen, Hughes & McMicken, attorneys. Both circulars are signed by John H. Bryant, president and general manager.

Washington County.—It is stated that work on the Maine Shore Line will soon be resumed and will be steadily continued to completion. It is expected that service will be inaugurated on the western division by October next, and that the eastern division (from Calais to Eastport and Charlotte) will be opened soon after. The middle section may not be completed in season for trains this year. Mr. George A. Curran, president of the road, has recently been in New York and completed successfully the final financial arrangements for the building of the road. Mr. James Mitchell of Portland, Me., is sole contractor.

NEW ROADS AND PROJECTS.

Arkansas.—Articles of incorporation have recently been filed with the secretary of state at Little Rock, for Arkansas Western R. Co., for the purpose of constructing railway, telephone and telegraph lines in Clay county, Arkansas, beginning at a point on the Iron Mountain within five miles of the Arkansas-Missouri state line, then for 40 miles to the West Central part of Randolph county, the offices to be at Paragould. The board of commissioners to open the books are S. B. Smith, A. M. Reynolds, W. D. Clark,

W. C. Hasty and S. A. Eaton, who constitute the incorporators of the new enterprise. The amount of capital stock is \$100,000, of which \$50,000 has been subscribed.

At Little Rock on July 8, articles of incorporation of the White River Valley & Western Ry. were filed with the secretary of state. The route is to be 250 miles long. It will run from Stillwell, I. T., to Bald Knob, Ark., thus traversing the fruit of Arkansas, and will develop an untold wealth of mineral, agricultural and timber resources. George A. Haggarty, Fayetteville, Ill., is president; G. H. Candel, Lowell, Mass.; Charles Bubbidge, Brooklyn, N. Y.; Egbert Gurnsey, New York, and George P. Bassett, Cincinnati, O., are principal incorporators.

California.—The right of way for the Yosemite Valley & Merced River road has all been secured and it is said that the building of this road, which is to connect Merced, Cal., with the Yosemite Valley, will now be pushed rapidly. The grading will be divided into two contracts, the first one to cover the first 46 miles from Merced toward the Yosemite, and the second to comprise the remainder of the distance.

Indiana.—A special meeting was recently held by the citizens of Penn township, Indiana, and voted a subsidy amounting to \$17,000 to aid in building the proposed Indiana Central road. The survey is now complete from Huntington to Union City, and the engineers are at work between Napanee and Lawrenceburg. This last subsidy makes a total of \$200,000 county aid which has been voted.

Under the name of Elkhart & Michigan a company has been incorporated in Indiana to build a line 10 miles in length from Elkhart, Ind., to a point in Cass county, Mich., and ultimately to Kalamazoo. The incorporators, who are mostly Elkhart capitalists, are J. L. Broderick, J. R. Beardsley, H. E. Bucklin and D. F. Coe, S. Maxon.

Iowa.—At Primghar, Iowa, articles of incorporation of a new populist railway have been filed. The road will be known as the Western Iowa Railway, and will run from Hartley, O'Brien county, to Sioux City, a distance of about 70 miles. No dividend in excess of 5 per cent is permitted, and no interest bearing debt is to be contracted. Each stockholder will be confined to one vote. Capital stock, \$750,000.

A rumor is in circulation in railroad circles to the effect that the Chicago, Milwaukee & St. Paul Co. has agreed to build a line from Spirit Lake, Iowa, to Jackson, Minn. The old "Carpenter" grade will probably be followed, and work commenced in the near future. The Milwaukee now forms a rectangle in northwestern Iowa, southwestern Minnesota and southeastern South Dakota. At the northwest corner of this rectangle is Egan, S. D.; at the northeast, Austin, Minn.; at the southeast, Mason City, Iowa, and at the southwest, Canton, S. D. At about the center of the south line is Spencer, Iowa, and from this point to Spirit Lake, 22 miles, a spur has been completed. By continuing this spur 25 miles farther to Jackson, Minn., the road will divide the rectangle into two squares of equal size, giving one of the most complete systems in this part of the northwest.

Ohio.—The surveys are now being made for the Cleveland & Southwestern road between Cleveland and the western line of Ohio. The majority of the right of way between Lima and Spencerville, has been secured, and the work of securing right of way west of Toledo is being pushed with all possible speed. It is hoped by the representatives that all the right of way will be secured before the last of August, at least enough to warrant the commencement of construction. The proposed line will pass through Elyria, Norwalk, Tiffin, Lima, Spencerville, Portland and Anderson. Mr. G. M. Anderson of Detroit and Mr. D. R. Cook of Hastings, Mich., who have opened headquarters at Toledo, are meeting with more flattering success than was at first anticipated, and receive encouragement from parties who a short time ago were objecting to the enterprise. Mr. Thomas H. Beer of Bucyrus, Ohio, is president.

Oklahoma.—On July 1 the management of the St. Louis, Oklahoma & Western closed a contract for the construction of the road as far as Oklahoma City at \$12,000 per mile, the new line to be completed between that point and Sapulpa within one year. The proposed line is to run from Sapulpa, I. T., the southern terminus of the St. Louis division of the Frisco line, via Oklahoma City through Greer county, to some point in Texas. This will give the Frisco the short line to Oklahoma City, at which point the shops and general offices of the new road are to be located.

Pennsylvania.—A charter was this week obtained for the Quakertown & Eastern Railroad Co., to build a line 15 miles in length between Quakertown and Riegelsville in Buck county. The president is John Jameson, Bloomsburg; directors, John J. Ott, Pleasant Valley; N. N. Souder, Quakertown; James H. Shelly, Richlandtown; H. S. Funk, Springtown; H. C. Coleman, Norristown; David A. Fluck, Richlandtown; Henry S. Mill, Springtown. Capital stock \$150,000.

A road was recently incorporated in Pennsylvania to be built from Brookville, Jefferson county, to a point in Polk township, a distance of 13 miles. This road, which will be called the Brookville, will be practically a branch of the Allegheny Valley and will be operated by that company when completed. Active work will soon begin and it is expected that the rails will be laid before winter. The road is to be built chiefly for the transportation of timber and bark from a large timber tract in Polk county. The incorporators are David McCargo, Wm. K. McElroy and Frank M. Ashmead. Levi Heidrich of Brookville is president. The principal office will be at Brookville. Capital stock \$130,000.

INDUSTRIAL NOTES.

Cars and Locomotives.

—The Indiana Tank & Refining Co., office 763 Rookery, Chicago, has recently been organized to transport oil. Fifty tank cars will be built for this purpose shortly. Bids are now being asked. T. A. Graves is manager of the company.

—The officers of the company deny that there is any ground for the rumor that the Grand Trunk will soon buy several thousand cars, probably 3,000 or 4,000.

—Specifications were sent out and bids asked for by the Swift Co. for building 100 or more refrigerator cars.

—Street rumor has it that the Lackawanna has is about to negotiate for the purchase of 1,200 new cars.

—The Boston & Albany is reported as being in the market for quite a number of passenger cars.

—The car shops of the Pennsylvania Railroad at Ft. Wayne, Ind., have completed 175 gondola cars and are now building 25 diary product and 10 furniture cars.

—The Georgia & Alabama has given an order to the Richmond Locomotive Works for six new locomotives.

—The Brooklyn Heights Railroad, New York, has issued specifications for 125 cars for its electric street lines.

—The St. Charles Car Works have just completed three 60-foot postal cars for the St. Louis & Iron Mountain, embodying several improvements suggested by E. J. Peck, general superintendent of that road.

—The Universal Construction Co. has had five steel cars on exhibition at the passenger station of the Lake Shore & Michigan Southern Railway in Chicago during the past week. Among them are the Harvey flat car and one of the improved Pennock flat cars, as illustrated in the RAILWAY REVIEW of May 30 of the current volume, as well as the hopper ore car, which was illustrated in the issue of June 13, these three cars being the ones which were exhibited by this company at the conventions in Saratoga last month. In addition to these cars there were two of the gondola type weighing respectively 31,000 lbs. and 30,650 lbs., both being of 80,000 lbs. capacity. These cars are constructed upon the same lines as to the floor system and framing as the Pennock flat car, which was illustrated and described in detail in the RAILWAY REVIEW of November 23, 1895, page 650. Upon the flat car, therefore, the sides of the gondola have been constructed of $\frac{1}{4}$ in. steel plates with a reinforcement at the top of an angle of about $3\frac{3}{4} \times 3\frac{3}{4}$ in. in section, and further stiffening of the sides and ends is provided by additional angles placed vertically and riveted to the side plates. The difference between the two cars consists in the provision upon one of them for unloading loose material through a series of doors arranged along the deck upon each side through which the load may be shoveled or allowed to fall by gravity, as the doors open outwardly. These cars are neat in appearance and give evidence throughout of good design and promise good working qualities in service. The trucks are especially heavy and were furnished by the Haskell & Barker Co. With reference to the records of the Harvey flat car, it should be stated that a communication has just been received from the Universal Construction Co. to the effect that one of the cars exactly like that which was exhibited at Saratoga was recently noticed in the yard work by Mr. Brimson, president of the Lake Shore & Eastern Railway, with a heavy service load of pig iron. The load was so large as to attract his attention and he ordered it to be weighed, whereupon it was found that it was carrying 131,800 lbs. and it was none the worse for the treatment received.

Bridges.

—It is reported that the contracts have been let for the 500 ft. iron truss bridge over the Allegheny river at Warren on the Philadelphia & Erie, and work will be begun at once.

—The director of the public works, of Cleveland, has been authorized by the city council to advertise for proposal for building a wagon and footbridge on Seneca street over the tracks of the C. & P. and L. S. & M. S. railroads from Seneca street extension to Lake Erie, with the necessary foundations and approaches.

—The Edge Moor Bridge Works, Wilmington, Del., has received orders from the Baltimore & Ohio Railway for three bridges: Bridge 61, 2d division, over south branch of the Potomac river, three spans, double track, triangular truss, 129 ft. each; bridge 77, 2d division, over Potomac river, two spans, double track through trusses 160 ft. 6 in. each; bridge 88, 3d division, over Big Yough river, two spans deck riveted truss, double track, 39 ft. each.

—A meeting of the stockholders of the Pittsburgh Bridge Co. will be held August 25 for the purpose of voting on increasing in the capital stock of the company from \$250,000 to \$350,000.

—Bids are asked until July 21 for erecting the piers for the Charlestown bridge, Boston, Mass.

—The Penn Bridge Co., of Beaver Falls, has secured the contract for the erection of a bridge over Pine run, Mercer county, Pa., together with four others in the same county.

—It is proposed to renew the floor system and to make other repairs to cost about \$80,000 to the Point Bridge, Pittsburgh, which was recently purchased by the city at a cost of \$400,000.

—The Pencoyd Iron Works, Philadelphia, has the following contracts for the Baltimore & Ohio Railway:

Bridge 12, C. O. division, consisting of four spans, about 128 ft. 6 in. each, single track through truss, over Muskingum river; bridge 45, midland division, deck truss, one span, single track, 100 ft.; bridge 48, midland division, deck riveted truss, single track, one span, 100 ft.; bridge 23, 5th division, one span, single track, deck plate girder, 54 ft.

—The Nypano Railroad will soon build a \$40,000 bridge across the Shenango river at Sharpsville.

—Plans are asked until July 23 for the superstructure for a new bridge over Newtown creek, between Manhattan avenue, Brooklyn, and Vernon avenue, Long Island City.

—The contract for the bridge over Nine Mile Run, in Schenley Park, to take the place of the present structure, was awarded to George T. Richards. The price is \$240,000.

—Contracts have been let by the Duluth-Superior Bridge Company to Alexander McGraw of Philadelphia, and to the Pennsylvania Steel Company, for the construction of a combination railway, street car, wagon bridge to extend from Rice's Point in the city of Duluth, Minn., to Conner's Point in the city of Superior, Wis. The former will have the building of the substructure while the latter will have the erection of the superstructure. This bridge will form an additional link between the railway systems of the two cities, which are now connected only by two single track bridges. The substructure will be of masonry piers and abutments on concrete and pile foundations. The bridge proper will be composed of one 400 ft. draw span and two 300 ft. through truss spans, and will have a 20 ft. clearance above surface of the water. Two railway tracks will occupy the 28 ft. between trusses, outside of which on either side will be a space of nine feet for wagons and street cars, while outside of these a four foot walk will be built. It is the intention to have the work all completed by the opening of navigation of 1897. A. P. Boller of New York City is consulting engineer for the company.

Buildings.

—The Mallory Line sheds at Galveston, Texas, extending from pier 24 to pier 28, were burned July 2, together with their contents. A train of twenty-six empty freight cars on the track were consumed. The sheds were owned by the Mallory Line, but the docks were the property of the wharf company. The largest shed was 1,200 ft. long by 100 ft. wide. The next largest shed was 400 ft. long. The secretary of the wharf company says the wharves and sheds will be rebuilt at once. The Gulf, Colorado & Santa Fe lost 25 freight cars.

—The contract for the steel superstructure of the new plant of the Slaymaker-Barry Co. at Connellsville, Pa., has been let to the Maryland Steel Co., Sparrow's Point, Md.

—The Warren Boiler Works, Warren, Ohio, has addressed a communication to the Board of Trade of Niles, Ohio, stating that it is about to erect a new building to accommodate an increased business, and desiring to know what inducements the citizens of Niles would offer to secure the same.

—A committee has been appointed by three of the railway companies centering in Omaha, Neb., to investigate the advisability of erecting a union passenger station. D. J. Whittemore, chief engineer Chicago, Milwaukee & St. Paul Railway Co., Chicago, Ill.; and T. E. Calvert, general superintendent Burlington & Missouri River Railway Co., Lincoln, Neb., are on the committee.

—Special Master Prather has filed in the federal court his report on the application of Receiver Abeel for a new \$10,000 freight depot at Waco, and a new \$3,000 passenger depot at Marlin, on the Waco & Northwestern. The report is similar to a former report on the same application, finding the present structures inadequate, and recommends that the new ones asked be built and paid for out of the accrued earnings.

—The Chicago, Rock Island & Pacific, the Pennsylvania and the Lake Shore & Michigan Southern railways have in project the erection of a transfer and passenger station at Englewood as soon as the tracks have been properly elevated. The structure will be built at the intersection of the above companies' lines.

—Mr. W. K. Henderson, Jefferson, Texas, is to erect in Shreveport, La., a foundry, machine shop, and woodworking establishment for building cars, and will remove his present plant at Jefferson to that place. The building will cover about 20,000 square feet of floor space.

—It is reported that the Missouri, Texas & Kansas Railroad and the Texas Midland Railway will combine in erecting a \$25,000 union depot at Waxahatchie, Tex. Mr. E. H. R. Green, manager of latter, Terrell, Tex.

—The Nashville city council has passed a franchise which ensures the erection of a depot at that point. It will cost over \$500,000, and will be built by the Louisville & Nashville Railroad Co.

Iron and Steel.

—Plans are drawn for an iron and steel industry on an extensive scale which it is proposed to establish in Duluth in connection with the blast furnace already established at West Duluth. R. S. Menger and O. H. Simonds have been working for several months to secure the establishment of this industry. The plans contemplate an open hearth furnace, in connection with the present blast furnace, blooming mill, rolling rod mill, wire drawing mill and steel wire nail mill.

—A test of armor-plate was made at Indian Head, July 3

in the presence of several ordinance officers of the Navy Department. The object was a section of the d'Humy plate, 48 inches in thickness and composed of segments 8 inches thick. It was not able to stand the test of a shot from an eight-inch gun firing at a velocity of 1,250 feet a second. The shot struck the lower right-hand corner of the plate, and the result was its thorough demolition.

—The Colorado Iron Works Co., of Denver, Col., has just completed arrangements with Mr. C. T. Finlayson, of that city, for the exclusive right to manufacture and sell Finlayson patent wire rope tramway.

It is stated that the stockholders of the Aetna Standard Co. have decided to issue \$200,000 worth of bonds for the purpose of erecting a large steel plant south of the Aetna mill at Martin's Ferry, O.

—The Franklin (Pa.) Steel Casting Company has withdrawn in the last few days made contracts for the manufacture of over 5,000 tons of car couplers, aggregating over \$200,000, and has orders besides for general steel casting work aggregating about 300 tons a month.

Machinery and Tools.

—Among the many manufacturing concerns that deserve well of the newspaper fraternity the Verona Tool Works occupy a high plane. This paper is glad to record that this firm on receiving a bill for subscription for the current year, not only promptly sent their check for the amount, but voluntarily added twenty-five cents to pay exchange on the check. A house that will do that without solicitation can be relied upon to give value received on all orders entrusted to it.

—The Pennsylvania Lines have ordered the following Ingersoll-Sergeant piston inlet air compressors. All to be half duplex, class "G" pattern, with Myer valve gear. Steam cylinders 10 in. diameter; air cylinders, $10\frac{1}{4}$ in. diameter; stroke 12 in. viz: one for Terra Haute, Indiana shops, one for Indianapolis, Indiana shops, one for Columbus, Ohio shops, and the fourth for Denison, Ohio shops.

—The Dodge Mfg. Co., of Mishawaka, Ind., during the past month has received large orders from the National Malleable Castings Co. for Dodge patent American system of rope driving; from the United Elevator Co., of Pleasant Bend, Ohio, for a complete grain elevator outfit, also several large orders consisting of general power transmitting appliances from Mexico. The Lake Shore & Michigan Southern Railway Co. has also lately placed with the company an order for complete equipments of power grain shovel machinery, to be placed in the Lake Shore & Michigan Southern grain elevators in Toledo, O. For a long time the Lake Shore & Michigan Southern Railway Co. has utilized, in unloading cars, nothing but manual labor, but at length, being convinced of the great saving—at least 50 per cent—derived from the use of power grain shovels, placed the above order.

—The Vulcan Iron Works, 86 North Clinton street, Chicago, are building the new bridge turning machinery for the Wells street bridge when the latter is re-built.

—Messrs. Hill, Clarke & Co., Chicago, report that they have just received a cable order from London, Eng., for forty Brainard milling machines, making sixty of these tools ordered by the same English firm within the last month.

—The stockholders of the Carborundum Manufacturing Co., of Monongahela City, have voted to increase the capital stock from \$100,000 to \$200,000.

—The Diamond Machine Co., of Providence, R. I., is shipping to the Japanese government a large order for grinding machinery received through its London house. The shipment comprises a large number of articles, including 10 of its large size water tool grinders.

Miscellaneous.

—Local papers state that the Galveston Wharf Co. of Galveston, Tex., has voted to erect two new grain elevators at a cost of about \$200,000.

—The court has authorized the sale of the old Harrisburg (Pa.) Car Works which have long been idle. The order of sale was the result of a bill in equity filed by stockholders of the car company.

—L. K. Hirsch, 549 The Rookery, Chicago, has recently sold and delivered at Shawnee, Okla., all rails, cars and locomotives necessary for the equipment of the St. Louis, Oklahoma & Texarkana R. R. Mr. Hirsch makes a specialty of equipping railway lines with second-hand rolling stock, as well as with relaying rails.

—The Luce automatic car brake is to be manufactured by a company recently organized at Meadville, Pa.

—Green's Car Wheel Manufacturing Co., St. Louis, is keeping its foundry fairly busy on orders from the car companies, the local brake works and the wood-working machinery manufacturers.

—The Ohio Falls Manufacturing Co. has paid dividend No. 12 of \$2 per share on its preferred stock, making \$4 per share paid this year, the previous dividend being \$2 per share, April 2. In 1895 \$2 per share was paid January 3, being the only dividend that year. In 1893 and 1894 regular quarterly dividends of \$2 per share were paid.

—The New York Car Coupler Co., of 126 Liberty street, New York, exhibited its automatic coupler at the conventions at Saratoga Springs, where the company was represented by Mr. P. H. Wilhelm, general agent. This coupler has an opening device which received favorable attention from railroad men. It is manufactured at Alliance, O., and was also shown at the Alexandria Bay conventions of last year. The address of Mr. P. H. Wilhelm is at the Palmer House, Chicago.